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S. Prentiss Baldwin

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IN MEMORIAM: SAMUEL PRENTISS BALDWIN

BY S. CHARLES KENDEIGH

Plate 1

ORNITHOLOGY lost a resourceful pioneer in the passing of Samuel Prentiss Baldwin. He was fully as much a pioneer in both spirit and deed as any explorer of unknown realms either present or past. Exploration for him was into new fields of thought, into the development of new methods, and into the establishment of new facts to add to world-wide wisdom. These explorations led him no farther than his own garden and farm and into the minds and manners of our most common birds.

Samuel Prentiss Baldwin was born in Cleveland, Ohio, October 26, 1868. He died of coronary thrombosis in the same city on December 31, 1938. Never of very rugged constitution even from early youth, he had nevertheless, by intelligent conservation of energies, led an active and useful life.

The Baldwin ancestry in this country can be traced back to Sylvestor and Sarah Bryan Baldwin, natives of England, who became Massachusetts colonists in 1638. The line led to Hon. Charles Candee and Caroline Sophia (née Prentiss) Baldwin, parents of Samuel Prentiss and one daughter, Mary Baldwin, who became Mrs. John Sawyer. Charles Candee Baldwin was a judge of the circuit court of appeals of Ohio but, in addition to his law practice, was widely known for his writings in archaeology and general science. These interests of the father served as inspiration to the son, who became engrossed in similar pursuits. In his early days, Samuel Prentiss collected birds and birds' eggs extensively and later built up a collection of native plants of parts of Ohio and New Hampshire. When only eighteen years old, he became an assistant to Professor G. F. Wright, the well-known geologist, and went with him on expeditions to explore Muir Glacier, Alaska, the Snake River Valley between Yellowstone and Oregon, and later went with him to Europe to study glacial geology. This early interest

in geology was so keen that after graduating from Dartmouth College in 1892, he continued his studies in this field. His researches dealing with the glacial topography of the Lake Champlain region were of such high caliber that he received a Master of Arts degree in 1894 from his Alma Mater. Later he was honored by election as a Fellow in the Geological Society of America. While busy reading law in 1893, he spent a year in New Mexico, partly for reasons of health, but also to make a geological survey of the northeastern part of what was then a territory. This work was so well done that in recent years, a resurvey found little to be changed. In spite of both their interests in natural science, Samuel Prentiss' father discouraged him from taking up this field as a profession largely because of the lack of financial opportunity in it. Therefore, he turned to law, mastered it largely by his own efforts, and graduated in the first class from the Western Reserve Law School with the degree of LL.B. in 1894. He was admitted to the Ohio bar that same year and began practicing at once in the firm of Ford & Baldwin. About 1900 his health failed him and he retired from law but continued in a business career. It was at this time that the Williamson Company was formed, which he helped to organize and in which he held various offices until the time of his death, and the Williamson building was erected. At the time of its construction it was the tallest and most pretentious building on the Cleveland Public Square. This business venture proved so successful that in 1908 the company purchased the New Amsterdam Hotel and in later years greatly enlarged it by the addition of more rooms.

On February 15, 1898, Samuel Prentiss Baldwin married Lilian Converse Hanna also of Cleveland. Although without children, Mr. and Mrs. Baldwin had a happy life. From June to October of every year since 1901, they lived on their beautiful Gates Mills estate, except for the month of August, which they usually spent on the seashore at Magnolia, Massachusetts. The rest of the year found them at their home in Wade Park in Cleveland, although previous to 1924, they often journeyed to Thomasville, Georgia, for two months in the late winter. Their country home at Gates Mills is of New England architecture which, in fact, is almost universal in this small suburban village nestled in the deep Chagrin River valley. The Baldwins were always a guiding influence in the development of this village and surrounding country; they planned and named the streets and really turned it into a transposed bit of New England. They were prominent in social life both here and in Cleveland and sponsored many worthy civic and philanthropic projects.

Mr. Baldwin listed himself as a Presbyterian. Human nature and relations of mankind deeply interested and concerned him, and in various ways he contributed to the welfare of people with whom he came in contact. Many of his associates in science and business are in debt to his kindness for

their present attainments and position in life. With people in all ranks of life, his contacts were of the best and he was highly respected.

Following again in the footsteps of his father, who was one of the founders and supporters of the Western Reserve Historical Society, Samuel Prentiss was a trustee of this institution from 1907 until the end of his life. Likewise, since 1923, he was a trustee of the Cleveland Museum of Natural History and was an active and enthusiastic sponsor of its development. Other honors came to him. He became research associate in biology at Western Reserve University. Dartmouth College, recognizing the importance of his contributions to the development of ornithology, granted him the degree of Doctor of Science in 1932. Having been a member of the American Ornithologists' Union since 1917, he was elected a Fellow in 1934. Since 1930, he has been honorary president of the Northeastern, Eastern, Inland, and Western Bird-banding Associations, a title sponsored for him, I believe, by his friend, the late William I. Lyon. The American Society of Naturalists honored him with membership. In addition to scientific organizations already mentioned, others to which he belonged included the American Association for the Advancement of Science, in which he was a Fellow, American Society of Zoologists, Ecological Society of America, American Genetic Association, Ohio Academy of Science, in which he also ranked as a Fellow, British Ornithologists' Union, Deutsche Ornithologische Gesellschaft, Australasian Ornithologists' Union, and the Cooper and Wilson Ornithological Clubs. In several of these organizations he held a life membership. These diverse fields provide some indication of the breadth of his interests in science.

When Samuel Prentiss turned from his early interest in geology to the practice of law and then later was compelled to give this up, his attention to business did not require all of his energy. This was the time that he and Mrs. Baldwin were developing their country home, and his interests naturally turned to flowers, trees, and horticulture in general. The plantings on his estate were made under his immediate direction, and he obtained a great variety of species from all over the country, most of which he could identify even to scientific names without a moment's hesitation. For many years he had a regular practice of making a complete survey through his gardens and lawns two or three or more times a week, and noting the time and order of leafing, flowering, and seeding. These data have not been compiled and summarized although one or two articles of a horticultural nature were published.

First an ornithologist, then a geologist, next a lawyer, then a business man, then a horticulturist, Samuel Prentiss Baldwin finally reverted to his first interest and during the last twenty-five years of his life was an earnest student of bird life. This pursuit of information concerning birds started

perhaps as an avocation but soon developed into the status of a vocation as it required the greatest share of his time and energies. Doubtless he will be remembered for two major contributions to the science of ornithology. The first of these—and upon which, perhaps, his reputation is primarily based—is the development of modern bird-banding techniques with a demonstration of type of results to be obtained and problems solved. The second is the development of methods of study and a biological point of view in the detailed study of the life history and behavior of the living bird in Nature, particularly as illustrated by the House Wren. There may be interest in tracing the progress of these two general contributions.

In his own words, Dr. Baldwin describes how he began trapping adult birds (1919):

> "About the year 1913 I began a diligent campaign against the House Sparrow, on my farm, at Gates Mills, near Cleveland, Ohio, using the so-called Government Sparrow Trap, which catches the birds alive and unharmed.
>
> "The Sparrows were destroyed in large numbers, and the farm pretty well cleared of them, greatly to the comfort, evidently, of the native birds; for it was very noticeable that, as the Sparrows decreased in number, the native birds greatly increased. The result was most satisfactory, and the traps should be recommended to all who are interested in attracting native birds to their vicinity.
>
> "But, it was when I learned of the American Bird-Banding Association that the traps acquired a new and much greater significance, for, as the House Sparrows decreased, the traps became the resort of various kinds of native birds.
>
> "In the spring of 1914 I began placing bands, not only upon young birds in the nest, but upon many adults secured from the traps, and by 1915 it became evident that this could be done on a large scale, and with most interesting results in returned birds."

The importance of the former American Bird-banding Association during this early period is evident. Though not successful in banding many birds, it nevertheless kept the idea alive and made available to those interested a limited number of bands. Dr. Baldwin often remarked that any special recognition he may have received for developing bird-banding was due in large part to his good fortune in securing bands from this association while others were compelled either to make their own or to wait until an additional supply became available.

During the years 1914 to 1918, sixteen hundred bands were placed on birds by Dr. Baldwin both at the Gates Mills, Ohio, estate and at Thomasville, Georgia. Only three of these birds were heard from again at other localities, although some sixty were retrapped at the same localities where first taken, some even the third and fourth years. The record of this banding was published in 1919 in the 'Proceedings' of the Linnaean Society of New York and at once aroused considerable interest. Results for the years 1919 to 1921 later appeared in 'The Auk' and showed increased perfection of the methods employed.

On the suggestion of ornithological friends, Dr. Baldwin told of his bird-banding experiences at the 1919 convention of the American Ornithologists' Union in New York City. This talk was a very stimulating and persuasive one. The next year the Biological Survey of the U. S. Department of Agriculture decided to assume responsibility for organizing the work in this country, since information obtained from the movements of banded birds would be of great value in the administration of the migratory-bird treaty, which had just come into existence two years before. The extent to which this bird-banding project had developed at the time of Dr. Baldwin's death may be realized from the fact that there were some 2,193 bird students cooperating with the Government in placing bands, and since 1920, these collaborators banded a total of 2,828,100 individuals. The method had become a well-established and necessary one in various types of ornithological investigations.

Of course, Dr. Baldwin did not originate the bird-banding method. He advanced the subject by showing how adult birds could be trapped and later retrapped so that a large percentage of returns could be obtained. Previously, bird students depended primarily upon the banding of nestlings, and further information from these marked individuals depended largely on chance recovery of dead birds. It was when recoveries of living individuals could be insured in a significantly high number of instances that the method became a valuable one. In his very first paper of 1919, he described various traps and devices employed. He continued an interest in the development of new methods during succeeding years and in 1929, together with Mr. F. C. Lincoln of the Biological Survey, published a complete manual for the use of bird-banders generally.

Dr. Baldwin never made a special point of banding large numbers of individuals for the sake of a big record. Rather an attempt was made to obtain all possible information from those that were handled. During recent years practically all birds captured were examined for malformations or injuries and were weighed, ectoparasites were collected, and notations made as to progress of molt. Usually the banding work was most intensive from late May to early September, although occasionally from April to November, and for a few years it was extended one day weekly or bi-weekly throughout the winter months. Up to the end of 1937, 21,682 birds belonging to eighty species had been banded at Gates Mills. Over half of these, 11,214 to be exact, were House Wrens in which a large number of nestlings are included. During the years of work at Thomasville, Georgia, which extended from 1915 to 1924 inclusive, 2,560 individuals of 38 species were banded. Including both these localities and allowing some for the season of 1938, the records for which have not yet been compiled, Dr. Baldwin has been responsible for the marking of about 25,000 individuals.

Banding, of course, gives the individual an identity. It permits an attack on ornithological problems from a different angle than had previously been prevalent. Instead of discovering general principles from the activity of species and then applying these principles to the interpretation of behavior of individuals, the reverse is true. Reactions of a large number of individuals are recorded and from this multiplicity of detail generalizations applicable to the general species may be formulated. Concepts arising in this manner are not only more trustworthy but also show the limits in which the concept holds true. This has had a very healthful influence on ornithological research and has influenced and stimulated the recent splendid studies in bird behavior, territory establishment, social relations, migration phenomena, and nesting activities of various sorts. Dr. Baldwin was early aware of the great value of this approach to the study of birds. His very first 1919 paper is filled with case histories of individuals and their differences in behavior are noted. Doubtless this paper will go down in the annals of ornithology as one of the classic publications of all time in this science. It opened a whole new field for ornithological endeavor and the results have been fruitful.

One of the early objections to bird-banding that made some people hesitant about adopting it was the possible harm it might cause the birds handled. Dr. Baldwin fought this idea diligently and published a special article on the subject in 1924. Repeatedly he demonstrated that because of banding, the use of bait at the traps, the erection of boxes, and planting of suitable trees and shrubs to make a better trapping station, the abundance of birds around his home was increased and the native birds were not frightened or driven away. After twenty-five years of trapping and intensive study of birds on his Gates Mills estate, the 'Bird-Lore' breeding-bird census for 1938 showed that the fifteen acres around his home ranked fourth highest in density of bird population out of 38 censuses in all sorts of habitats all over the country. In 1931 he published a short article on how to encourage birds around the home. Cats, red squirrels, and English Sparrows were the only enemies of native birds he advocated eliminating. This is well shown in the following quotation, which also illustrates his manner of expression: "*Cats:* I allow no cats on the place; I have no grudge against the cat, but I am raising birds, not cats. A friend of mine assures me she has a perfectly good cat that does not catch birds, but I would not have such a cat, it is not a healthy, normal cat; when a cat has so lost its spirit that it no longer enjoys the sport of catching live game, and is content to eat out of a dish, it is no longer much of a cat."

Throughout the vicinity of Cleveland and even throughout the State of Ohio, Dr. Baldwin's name was a potent one in conservation. He continually fought against the cutting out of underbrush from city parks and the walling

in of city streams to resemble "open sewers" where no wild animal could safely go down for a drink; he advocated constructive measures in bird protection and the increase of birds. Probably his biggest battle was fought for the protection of hawks and owls in Ohio. This demanded his constant attention, more or less, for two years. Here his training in law helped him well as did also his very wide acquaintance among the influential people of the State. As a result of this campaign, the bounty law was repealed, the hawk and owl law clarified to such an extent that only two or three species were left unprotected, and the farming and sportsmen's organizations were educated as never before to the value of these birds of prey. The legislature and leading officials were converted to the conservation point of view and what was even more valuable, they were convinced of the desirability in turn to educate their followers in the various sportsmen's and farmers' organizations. This campaign demonstrated to Dr. Baldwin's satisfaction that the better class of members in these two groups, which are frequently considered opponents of conservation, are reasonable and when given the facts often come over to the other side. The problem of conservation seemed to be, therefore, a problem of mass education. The good of the campaign was probably not so much the changes in conservation laws effected as the initiation of educational programs among the various organized groups over the State.

Along with the fight for the birds of prey, the question as to whether or not the Bob-white should remain on the songbird list was also in the forefront. This was before the present impetus for the management of wildlife was well under way, and the question was not of controlled hunting in local regions but of throwing down the laws for hunting by all throughout the State. That this latter would have been disastrous was demonstrated by arguments, and the species remained on the protected list.

Dr. Baldwin was not a hunter nor did he belong to any sportsmen's organization, although occasionally he tramped the fields with friends and relatives in Georgia in their pursuit of the Bob-white. He went along not to shoot but to enjoy the walk, the dogs, and the birds. He had much to do in 1923 with the organization and early planning of the Quail Investigation in Georgia under the Biological Survey, which had for its aim a thorough and complete study of this gamebird.

In his early years of bird-banding, Dr. Baldwin was coming more and more to concentrate on a special life-history study of his own on the well-known little House Wren. In his first paper in 1919, he includes an illustration of a box with a trapdoor useful for studying and banding wrens and Bluebirds, and in 1914, twelve wrens were banded. Later, hundreds of these boxes were erected on his own estate and on neighboring estates within a mile's radius, and the daily life of many birds was observed.

In later years the Ohio House Wren was recognized as a distinct subspecies and in recognition of his interests was fittingly designated *Troglodytes aëdon baldwini.*

One of the earliest things he discovered about the House Wren was the prevalence of 'divorce' and mating with other individuals for second broods or following years. This was reported in his first paper and later expanded into a special article on the 'marriage relations' of the House Wren, perhaps the first serious study of this sort undertaken on wild birds where, of course, the identity of individuals first had to be established. The similarity of this behavior as well as other intimate details in the life history of this bird to human behavior struck the fancy of the layman and received considerable newspaper publicity.

In order to extend his banding work at Thomasville, Georgia, over a longer period and to expand its scope, Dr. Baldwin arranged for an assistant to operate his traps there during the spring months of 1922, 1923, and 1924. Each year a different person held this position and was given the opportunity to publish his results. In 1924, this work was terminated because of a serious illness from which he required several months to regain full health. Thereafter, his scientific endeavors were confined to 'Hillcrest Farm' at Gates Mills.

Because of his convalescence and his desire not to interrupt the banding operations and life-history study of the House Wren, he decided to employ an assistant for the season of 1925. The assistant engaged was a nature photographer of ability, and as Dr. Baldwin had long been interested in photography, he conceived the idea of making a motion picture showing all phases in the life of the House Wren. This turned his attention to the development of the motion picture in ornithological exposition, and with the aid of the other assistants during the next five years, he obtained several additional reels of film showing bird-banding and other research methods. These films were all well done and edited with complete titles and raised the standard of this art in the field of ornithology. As a special feature of this development was his association with Bradley M. Patten, then associate professor of embryology at Western Reserve University, in conceiving and devising an apparatus for taking motion pictures through the microscope, one of the first such instruments built in this country. This brought forth several reels of pictures showing the development of the bird in the egg, details concerning the first beginning of heart beat and blood circulation, and is being carried on in the study of other related problems.

My own association with Dr. Baldwin began in 1925 when I was also employed during the summer as an assistant. Each summer thereafter two or more assistants were regularly present; during some years there were as many as five. Dr. Baldwin was always very good and generous to his

assistants, aiding them in many ways in their training both in science and in the ways of life. He tried always to develop the best in their character and ability. His assistants both valued his deep interest and respected him highly for his excellence as a man.

With this acquiring of a staff of research assistants, the Baldwin Bird Research Laboratory was definitely born, a suitable building was erected, and a research library started. Up to the present time and including publications that appeared before 1925, a total of thirty-four contributions to ornithological science has appeared. Research notes fill forty-four large typewritten volumes. Four copies of each year's field and laboratory notes were always made and distributed in different places as insurance against fire and loss. There remains to be prepared, however, a monograph summarizing all this work, especially with the House Wren, a good share of which has never been published and which should make a complete life story of this bird.

The development of apparatus and methods has been an important function of this laboratory and continually engaged Dr. Baldwin's attention. Aside from bird-banding, trapping, and the photomicrographic outfit discussed, instruments for recording nest activity and temperature have been most important. Their use has had an interesting development as one research led to another. Very early in the study it seemed desirable to know whether and how often the adult birds spent the night in the nest box, or if the male spent the night in one of his supernumerary nests. The latter supposition is not true but it was found that the female stayed in the nest box during the egg-laying period and often before any eggs were laid. The question then arose as to the amount of incubation the first eggs of a set received before the last ones were laid. Some method was desired to obtain nest temperatures without disturbing the adult birds. At this point, Dr. Baldwin Sawyer, a nephew of Dr. Baldwin and director of the Brush Laboratories of Cleveland specializing in research in physics, suggested the use of a thermo-couple. This consists of a thin wire that could easily be strung through the nest over or under the eggs and carried to a recording potentiometer in the laboratory. In 1926, this apparatus was obtained and the recording of nest temperatures was begun. Immediately it was evident that much interesting information regarding periods of attentiveness and inattentiveness or time on and off the eggs could be obtained from the changes in nest temperature that occurred. This led to the publication in 1927 of a paper describing the periods and the method of recording. Since then much additional information has been obtained on many species and this is in process of compilation.

However, periods on and off and number of times the young birds were fed could not be determined by changes in the temperature of the nest after

the eggs hatched. A new method was required. About this time, while in Massachusetts on vacation, Dr. Baldwin obtained an idea that birds may be weighed as they come to their nest by stepping on a specially prepared perch. From this the concept developed that perhaps as the House Wrens came to their boxes, their weight could be made to press down the perches on the front of the boxes sufficiently to make an electrical contact, thus registering their visits. However, it would not tell whether the bird had simply alighted on the perch and flown away or had entered the nest. This would be remedied by having two perches, one just inside the entrance, so that the outer perch when it made its electric contact would throw the pen one way, the inner perch would throw it the other way, thus telling the direction of the bird's moving. Hence came the 'wrenograph,' a name which was later changed to 'itograph,' a word of Dr. Baldwin's own invention, for more general application. Since this time, the itograph has been successfully applied to several species with open nests not in boxes and has also been used to record activity of mammals and reptiles.

To return to the temperature-recording instrument, the thermo-couple at various times was inserted below the eggs to get nest temperatures, inside the egg to obtain the temperature of incubation, and just above the eggs so that when incubating, the female adult bird was compelled to sit directly on it so that her skin temperature was recorded. Many measurements of daily rhythm in temperature of adult birds on their nests were obtained in this way as well as effect of various activities. From this the step was natural to study temperature relations of birds in the laboratory under controlled conditions where the effect of all sorts of factors could be determined. Even more accurate temperature-reading instruments were obtained. Limits of tolerance of birds to extremes of environmental temperature were determined. An attempt was made to correlate an understanding of the temperature reactions of birds obtained in this way with their limitation of distribution in Nature, with the cause of their migration and variations in their abundance. Dr. Baldwin's idea always was to correlate controlled laboratory experimentation with careful determinations of bird activities in Nature. Both physiological and ecological studies profit from an interchange of methods and results. Actually these studies are in the borderline between these fields. Should we not give Dr. Baldwin recognition for helping to invigorate another new field of ornithological research in the physiological ecology of birds?

This study of bird temperatures did not end here. Very early it was discovered that newly hatched wrens were essentially cold-blooded in their temperature responses and an attempt was made to trace the changes from this poikilothermic state to the later homoiothermic one. Two reports have appeared analyzing the ontogeny of the temperature-regulating mechanism

in great detail. A better understanding of temperature regulation in adult birds can be obtained if a knowledge is available of how it develops in the young bird and the various factors concerned.

Involved in the development of a constant body temperature are not only a control over the rate at which heat is lost from the body but also a control over its production. To understand this latter control, measurements of the rate of metabolism or heat production in young birds was undertaken, and is being reported on in one of the papers referred to above. Naturally, this leads into similar studies with adult birds, which had just been started at the time of Dr. Baldwin's death. Various aspects involved in the metabolic responses of adult birds have been investigated, however. Rapidity of food digestion and daily requirements have been studied. A detailed analysis of variations in weight has been made, and relation of energy resources to amount of breeding has been investigated.

Another related study, well begun, is the study of rate of heart beat in birds. At least eight-years' time has been devoted to developing a method of recording this rate with the bird as little disturbed as possible. Here again, as with other instrumental technique, the Brush Laboratories have given invaluable aid, and an apparatus has been worked out, a description of which will soon be published, that records the heart rate of adult birds sitting undisturbed on their nests. This study of rate of heart beat will prove of special value if it can be shown to be an index of the rate of energy metabolism going on in the bird. The aim inherent in all these researches is to discover the mechanics of living in the wild, active animal.

Dr. Baldwin took a leading part in the development of all of these instruments and methods. His ideas were often the most useful and original ones. His various assistants contributed their special talents and trained abilities in various ways, but Dr. Baldwin's creative sense and resourcefulness of ideas often more than offset the training of his assistants in modern formal laboratory and research techniques. Without question Dr. Baldwin's place in the history of ornithology is an important one and it seems almost certain that the methods and ideas that he contributed will assume greater importance in the light of future ornithological knowledge. Doubtless his name will go down as one of the noteworthy ornithologists of all time.

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University of Illinois
Champaign, Illinois

LOCAL DISTRIBUTION OF EASTERN CANADIAN ARCTIC BIRDS[1]

BY J. DEWEY SOPER

Plate 2

COMPARATIVELY few naturalists have a clear conception of the manner in which birds are locally distributed in the Arctic regions. To many, the polar lands are synonymous with a poverty of terrestrial life. While this circumstance admittedly holds for numerous localities, it is very far from being true for all. In reality, the abundance of birds varies enormously from place to place and frequently a maximum degree of contrast obtains within very narrow limits. The truth is, indeed, that many favorable sections throughout the polar lands display a wealth and diversity of bird life well beyond the budding Arctic ornithologist's most sanguine expectations.

Some of the most spectacular aggregations of Arctic birds are to be found on coastal islands and cliffs of the mainland. These include colonies of King and Northern Eiders, Mandt's Guillemots and Brünnich's Murres (vernacular names follow the American Ornithologists' Union 'Check-list of North American Birds,' 1931, which will make unnecessary the addition of scientific terminology). Particularly notable in coastwise cruising are the breeding rookeries of Herring, Glaucous, Thayer's and Kumlien's Gulls, where the white plumage of thickly massed adults gleams in startling relief against the dark rocks of the towering cliffs. Another sight which once seen, can never be forgotten, is that of swarming multitudes of Dovekies on the icy waters and mountainous nesting acclivities of northwestern Greenland.

Aside from these highly localized colonies, the best breeding areas of a host of birds are to be found on flat, grass-tundra lands in various parts of the Canadian Arctic islands. Such areas of marked extent are relatively few and far between. In the eastern Arctic the best examples are to be found in southern Southampton Island, southwestern Baffin Island, the vicinity of Pond Inlet, southwest Bylot Island, and apparently, also, parts of western Ellesmere Island. The best development of grass tundra is found over horizontally bedded sedimentary rock. Where this is boggy and sprinkled with ponds and small lakes, the breeding population of birds reaches the peak of abundance. As a rule such tracts are practically at, or relatively close to sea-level, and in the geologically recent past were below it. The greatest of these known resorts in the eastern Arctic occurs in northern

[1] Published by permission of the National Parks Bureau, Department of Mines and Resources, Ottawa.

Foxe Peninsula and north along the Foxe Basin coast nearly to Hantzsch River and east to Nettilling Lake. The estimated total area of these plains approximates 8,100 square miles. Additional sections of noteworthy extent flank the eastern sides of Amadjuak and Mingo Lakes at a somewhat greater elevation. As an all-round breeding territory these western and south-central plains of Baffin Island are of a very superior order. The grass-tundra plain bordering Foxe Basin on the western side of the island, especially, is visited by vast numbers of geese, brant, waders and Eider Ducks, which either breed locally, or pass on to more northern latitudes. It was in this lowland region at Bowman Bay, incidentally, that I witnessed the passage of untold thousands of Blue and Lesser Snow Geese in the spring of 1929 and later in the season, discovered the main breeding grounds of the former species.

A great part of this western Baffin Island territory is of extraordinary interest and fascination to a naturalist. Unfortunately, it is not of easy access and to enter it at the season of migration and nesting, one is obliged to winter in the country and travel by dog teams with the Eskimo before the snow melts the following spring. These vast coastal plains are not only unusual as to migration, but are equally remarkable as breeding grounds for many birds. Dominant among the larger forms are Blue, Lesser Snow and Hutchins's Geese, King Eiders, Old-squaws, Parasitic and Pomarine Jaegers, Red-breasted Mergansers, Common, Pacific and Red-throated Loons, and Herring Gulls. Sabine's Gulls and Willow (White-shafted) Ptarmigan also occur in large numbers, especially as migrants. Two other members of the summer avifauna are Whistling Swan and American Brant, though they are uncommon and widely scattered. Among the smaller species the grass tundra is particularly rich in nesting Lapland Longspurs, Red Phalaropes, White-rumped, Baird's and Semipalmated Sandpipers, Black-bellied and Semipalmated Plovers. During migration the country teems with tens of thousands of Purple Sandpipers, all but a few of which leave for more northern regions. Other species which occur in lesser numbers are American Golden Plover, Red-backed Sandpiper and Ruddy Turnstone. In the light of present knowledge these plains, at large, stand in a class by themselves; avifaunally rich as they are in summer, they are especially notable for a line of migration which, for concentrated volume and persistence, probably has no counterpart in the whole of the eastern portion of the Canadian Arctic.

Another exceptionally fine bird locality was found at Nuwata, Foxe Channel, in late August, 1928. Nowhere, after four seasons in the eastern Arctic, had I formerly observed such an assembled wealth of bird life in a single district. There was an astonishing aggregation of various species of shorebirds and Arctic Terns, together with gulls, jaegers, divers, King

Eiders, Old-squaws, Hutchins's Geese, Lapland Longspurs and other birds. Some of these species, it is true, were then gathered in large flocks ready for departure from the country, but the Eskimos said that for the majority, the local coasts and adjoining lowlands were favorite breeding grounds. It would undoubtedly well repay a naturalist to explore this district during the nesting season. He would normally be obliged to voyage to Foxe Peninsula the previous year, winter at Cape Dorset, and then leave by sled in May for the Eskimo village at Nuwata. With headquarters camp at this point, the pool-sprinkled grass tundra in the vicinity could be thoroughly investigated and work carried farther afield to include the chain of promising lakes which occurs in extensive lowlands on the Foxe Basin watershed southeast of Cape Dorchester. The locality appears to lie on a markedly important migration route that extends to and from the Foxe Basin lowlands via Nuwata and Hudson Bay. Further supporting this supposition is the fact that no pronounced movement of the Limicolae, especially, has ever been observed along the south coast of the island.

Along Hudson Strait the Common Canada Goose resorts to a modified habitat of the grass tundra as found localized in rocky terrain near the sea, or in adjacent coastal valleys. It occupies this coast to the exclusion of Hutchins's Goose from Cape Dorset to at least Icy Cape, while the latter only is found nesting along Foxe Channel and Basin. Several species, including White-rumped, Baird's and Semipalmated Sandpipers and Lapland Longspur, breed in isolated tracts of grass tundra in hilly and mountainous districts, but they are always scarce in comparison with the population habitually domiciled on areas of equal size in great, uninterrupted lowland plains, such as those along the west coast of Baffin Island. Common residents of the grass-tundra districts, interspersed with rocky ridges, are Snow Bunting, American Pipit, Horned Lark and Rock Ptarmigan. They are invariably associated with granitic areas and are therefore absent in the wide, swampy tundras, except for sporadic companies during migration. Where isolated granite ridges protrude from these plains, however, a few pairs will be found nesting. In the lower Pre-Cambrian tracts with good to fair plant cover, the bunting and pipit are of almost universal distribution. The Horned Lark, on the contrary, exhibits marked variability in numbers from district to district; in the Nettilling Lake territory, for example, a greater abundance was displayed than seen elsewhere in the eastern Arctic islands.

Of all the species which nest at the lower elevations, the King and Northern Eiders congregate in the densest colonies. These are apparently always on low-lying islands near the coast, though small groups, or scattered pairs of both species, nest on swampy ground about freshwater lakes in coastal areas, or on islands therein; they breed as well on the major grass tundras

in the vicinity of Foxe Basin, but in greatly reduced numbers. Coastal nesting islands, while very rocky, are usually well furnished with lowly vegetation and are nearer to typical grass tundra than to the impoverished granitic areas which may be referred to as desert tundra. A notable feature in respect to these two species of ducks is that ordinarily their nesting areas are distinctly separated. Among off-lying islands along substantial lengths of seacoast, the Northern Eider may be seen in extraordinary abundance, where the King Eider is totally absent, while the contrary phenomenon holds in another district. Occasionally, and to a very limited extent, the local breeding ranges of the two overlap, but in their home life they nevertheless remain meticulously segregated. The Northern Eider, in particular, is extremely gregarious. It is especially abundant locally along the south coast of Baffin Island and in Cumberland Sound, while *spectabilis* is predominant along Foxe Channel and Basin.

Hitherto, the distribution of bird life has been considered for areas referred to as the grass tundra, where for most species optimum breeding conditions obtain. Next in order is the desert tundra, which in relation to the preceding is highly differentiated. It is rocky and chiefly barren, though impoverished examples of higher plants persist as cushion, or mat types, separated by terrain that is either bare or scantily clothed with lichens. This type of country is found mainly on well-elevated areas, such as the larger hills, and intermediate and higher slopes of mountains; it also frequently occurs on rocky outcrops and ridges only a few hundred feet high where peculiarly rigorous climatic conditions exist. In most Arctic regions the desert tundra is represented by areas of much greater extent than those occupied by the flat grass-tundra lands which were earlier discussed.

The desert-tundra type of country is poor in bird life over all interior areas. In fact, certain tracts are almost devoid of birds of any kind. Snow Bunting, American Pipit and Horned Lark are the species which are most likely to be encountered. All three nest sparingly in these more inhospitable wastes, but they are more commonly distributed over rocky territory in close relationship with meadows and grassy valleys among the hills. The same may be said of the Rock Ptarmigan; it is found inhabiting country varying greatly in elevation and general character, though superior numbers naturally inhabit lower levels where berries and other food are more plentiful. Other widely dispersed inhabitants of the desert tundra are White Gyrfalcon, Duck Hawk, Snowy Owl and Northern Raven. Greater and Hornemann's Redpolls range over widely diversified terrain during migration, but are not positively known, as yet, to nest anywhere in the Canadian Arctic islands. The Greenland Wheatear is one of the rarer Baffin Island birds and has only been observed in the mountainous eastern side of the

GRASS TUNDRA: FOXE BASIN

DESERT TUNDRA: BAFFIN ISLAND

island where desert tundra predominates in association with small representations of grass tundra.

From an ornithological viewpoint, inland tracts of desert tundra are of a highly impoverished character and will invariably be found disappointing. Very often hours of active travel afoot will reveal no more than a few buntings and pipits which, in any event, are apt to be met with in the most desolate and forlorn tracts of the polar lands. Pre-Cambrian rock country of the desert-tundra type is particularly pronounced along the ice-fettered coasts and occupies enormous areas. Land birds will always be found scarce here except in sheltered valleys and even there will be restricted to very few species of moderate numbers. The most conspicuous members of the coast avifauna are various species of seafowl; it is obvious that such birds while extracting their living from the sea are otherwise essentially independent and many nest in the most desolate situations imaginable on adjacent land masses.

Mandt's Guillemots, for example, resort to very barren and precipitous islands of Pre-Cambrian rock on which to breed. An indispensable feature is the presence of talus slides at the base of cliffs near the sea where the nests are hidden away among the boulders. This imposes a highly restraining influence on general distribution. Some sectors are so attractive for nesting that multiple colonies become established on numerous islands in a comparatively small area, while, again, long stretches of coast may be entirely devoid of them, except for small scattered bands of non-breeders. On islands carrying a wealth of boulder débris, the birds swarm in astonishing numbers. On low, featureless coasts such as upper Foxe Channel and Foxe Basin, in southwestern Baffin Island, the species is scarce, or entirely wanting.

Among this class of birds, Brünnich's Murres assemble in the most amazing abundance. Colonies are highly localized, and like gulls, gannets and auks, these birds nest on ledges of rocky cliffs overlooking the sea. Apparently few situations meet the species' requirements in every respect, as rookeries in the eastern Arctic are infrequent and widely separated. The best known is at Cape Wolstenholme, Hudson Strait. Decided by the prevailing geology of the region, most nesting haunts occur on cliffs of Pre-Cambrian rocks, but considerable numbers breed on ledges of Ordovician limestone at Akpatok Island, Ungava Bay. On Eskimo testimony, there are large nesting colonies in the Merchants Bay region. It is also evident that important breeding sites occur somewhere about Bylot Island, as in August, 1923, tens of thousands of murres were observed among scattered pan-ice along the northern coast of the island.

Many islands chiefly occupied by Eider Ducks also support assemblies of Herring, Glaucous, or Kumlien's Gulls, occasionally all three nesting

together on a single cliff. In such cases a portion of the island is high and steep, with rugged lowlands; elsewhere, comparatively well carpeted with vegetation. As a rule, the islands inhabited by gulls are so steep, barren and rocky that all other species are excluded except, perhaps, for scattered pairs of American Pipits and Snow Buntings. Islands of this nature are to be unreservedly placed in the category of the desert tundra. On a high percentage of these, the lowly plant growth is notably depressed as a result of exposure; milling field-ice commonly surrounds such islands until early July or later, long after Eider Ducks and gulls begin to nest.

While in many instances gulls of different species nest sociably together, they are also as frequently found breeding separately in colonies varying greatly in size. The most conspicuous of these are located on cliffs of the higher mainland that rise above the sea, in many instances, to heights of from 500 to 1000 feet, or even more. Such nesting sites are usually desolate in the extreme, but occasionally a lush growth of grasses develops on the nesting ledges and in adjoining rock crevices. While the various species of gulls have a wide breeding range, there are often long lengths of seaboard in which no colonies occur. Unlike Glaucous and Kumlien's Gulls, the Herring Gull nests widely on rocks in lakes and rivers of the lowlands, a habit which, if anything, is more characteristic of the birds than rearing their young on cliff ledges above the sea.

In addition to the two floro-topographic types of country previously mentioned in relation to bird life (grass tundra and desert tundra), there is another of very considerable coverage, which may be called the polar desert. This embraces the polar lands which are dominated by glaciers and ice-fields. In southern Baffin Island the only example is the Grinnell Glacier. In the high mountains of the central part (5,000–8,000 feet) there are numerous fields of perpetual ice and snow, while glaciers are common along Navy Board Inlet. The eastern side of Ellesmere Island is especially characterized by enormous accumulations of land ice. Such areas are, of course, entirely destitute of breeding birds and may be disregarded in a further discussion of Arctic avifauna. The polar desert together with the desert tundra occupies, by a considerable margin, the greater part of the Arctic land mass. There remains, therefore, only a minor portion (represented by grass tundra and less inhospitable parts of the desert tundra) which is suitable as a habitation for the majority of species that reproduce in the polar regions.

A feature to be particularly emphasized, in this connection, is the notable difference in the abundance of breeding birds as between hilly and mountainous sections of the Arctic on the one hand and lowland grass tundra on the other. On the whole, the latter areas in season teem with bird life. In the former, aside from local colonies of seafowl along the coasts, compara-

tively few species and individuals will be seen; as a rule, these will comprise only widely scattered passerines, Semipalmated Plover, Rock Ptarmigan and Northern Raven. Practically, if not entirely absent over the greater part of these rocky sectors of the desert tundra, will be geese, nearly all waders, Sabine's Gulls, Willow Ptarmigan, jaegers and other birds which are abundant as breeders on the grass tundra and especially those portions in close proximity to the sea.

From the foregoing remarks, it will be appreciated that a naturalist's larger success, and point of view concerning Arctic bird life, will be governed to a marked extent by his chances of reaching the various types of country which have been mentioned. This is especially true in regard to the scattered and localized breeding colonies of seafowl along the coast, and the great nesting areas of numerous species on the flat grass tundras; the latter, as a rule, are particularly isolated and infrequently seen. To reach these areas special side journeys are usually required away from the main routes of travel and for the best results, weeks in advance of the time that ships can approach the Arctic coasts. For this reason, late summer and fall expeditions to the Arctic regions, with a high percentage of the time spent at sea, are not entirely satisfactory to the student of birds. Moreover, where customary ports of call are confined to high, rocky coasts, limited ornithological opportunity is bound to result. If under these circumstances the observer is making his first visit to these latitudes, he is certain to carry home an inadequate conception of the bird resources of the territory.

In a table at the end of the paper some bird-census results are given which were obtained near Bowman Bay, Foxe Basin, in the summer of 1929. This type of record has not previously been made in Baffin Island. Investigation of this kind reveals wide variation from one area to another in the same locality, in respect to both the species and the number of individuals observed. Some areas are almost destitute of bird life, while others support heavy populations. As would be supposed, a high degree of differentiation also obtains in the dispersal of plant life, with which the birds of any region are closely associated. The counts made on the given unit areas are probably about average for very extensive plains adjoining Foxe Basin. In certain highly favorable sections of the same general district, appreciably greater numbers of birds were noticed per square mile—particularly geese, phalaropes and sandpipers—but opportunity did not offer to make detailed counts.

The three census lists, with explanatory notes, which were made on the Blue Goose Plains near Bowman Bay are as follows (for local map and detailed description of this locality see the author's 'The Blue Goose,' Department of the Interior, Ottawa, 1930, pp. 30–37):—

Census Area No. 1.—Situated south of Camp Kungovik in latitude 65° 31′ N., three miles east of Bowman Bay, and calculated to embrace a tract of one square mile. The area is chiefly grass tundra intersected by granitic outliers of the Eswituk Ridge, and bordered by a branch of the Blue

ARCTIC BIRD CENSUSES

Species	Area No. 1		Area No. 2		Area No. 3	
	Nests found	Resident birds	Nests found	Resident birds	Nests found	Resident birds
Pacific Loon		2	1	4		6
Red-throated Loon						2
Hutchins's Goose			1	4		
Lesser Snow Goose		8	2	10		4
Blue Goose		150	14	350		30
Old-squaw		8		18		6
King Eider	1	10	2	16	4	12
Willow Ptarmigan		8		4		4
Rock Ptarmigan		2		6	1	8
Semipalmated Plover				4		2
Black-bellied Plover	1	6		8	3	10
Ruddy Turnstone		10	1	20		
Purple Sandpiper		2				
White-rumped Sandpiper	2	18	2	26	6	20
Semipalmated Sandpiper		4		10		8
Red Phalarope	8	40	5	30	10	26
Pomarine Jaeger		2				
Parasitic Jaeger	1	6		4	1	6
Long-tailed Jaeger	1	4	2	8		2
Herring Gull		4		6	2	6
Sabine's Gull	13	40	3	20		8
Arctic Tern		10		40		4
Northern Horned Lark		6		8		2
American Pipit		2			1	4
Lapland Longspur	3	30	4	50	10	60
Snow Bunting	5	20	3	30	12	50
Total	35	392	40	676	50	280

Goose River. The list is based on observations made during the first three days of July. Nests in the table refer to those with eggs, and usually completed sets. Non-breeding birds of several species doubtless exist, as is the case with the Blue and Lesser Snow Geese, which do not nest in this area.

Census Area No. 2.—This lies immediately to the southwest of the preceding, with a branch of the Blue Goose River between. The parallel of latitude 65° 30′ north, intersects it, while its western boundary lies within a

mile of the high-tide contour of Bowman Bay. It embraces an area of about one and one-fourth miles square, composed of grass tundra with low outcrops of Pre-Cambrian crystallines. Half of the area lies south of these ridges and includes a portion of the great grass plain which extends from Bowman Bay to Putnam Highland. It encloses a portion of the breeding ground of the Blue Goose. Observations were made on July 4 and 5.

Census Area No. 3.—This is taken, as the others, to include both grass tundra and granitic tracts of the Eswituk Ridge, one square mile in extent west of Blue Goose River at Camp Kungovik. The area comprises about two-thirds typical flat tundra with numerous ponds, and the remainder granite-gneiss uplands rising ten to fifty feet above the adjoining plain. The result of this census is based on observations made from July 6 to 11. Estimates of the summer-resident birds of all the areas worked must be regarded as only approximately correct, while the number of nests found is probably no more than half of the actual number existing in the different areas. Nests of some species were not located, but it is practically certain that all were breeding within the locality.

536 Dominion Public Building
Winnipeg, Manitoba

EXPLANATION OF PLATE 2

UPPER FIGURE.—A modified example of the Arctic grass tundra interspersed with low Pre-Cambrian ridges and strewn with glacial erratics. Cape Alberta, Foxe Basin, July, 1929. Farther north vast areas of pure grass tundra occur unrelieved by any boulders or rock outcrops. Both types of country support a wealth of bird life.

LOWER FIGURE.—Rugged granite and gneiss terrain near McKellar Bay, Baffin Island, early June, 1931. A typical section of the desert tundra where vegetation is greatly impoverished and bird life reduced to a minimum.

EGG RECOGNITION BY THE LAUGHING GULL

BY G. K. NOBLE AND D. S. LEHRMAN

SEABIRDS, such as gulls, terns and plovers, differ remarkably from one another in their ability to recognize their eggs. Tinbergen (1936) concluded that terns on returning to the nest orient themselves by cues derived from the eggs to a much greater degree than does either the Herring Gull (*Larus argentatus*) or the Ringed Plover (*Charadrius hiaticula*). While studying the social behavior of the Laughing Gull (*Larus atricilla*) we had the opportunity to test experimentally the cues utilized by this species in satisfying its incubation drive.

Considerable work on the adequate stimulus for incubation had been done previously on the Herring Gull, *Larus argentatus* (Goethe, 1937; Tinbergen, 1934, 1936; Booy and Tinbergen, 1937; Steinbacher, 1937) and European Black-headed Gull, *Larus ridibundus* (Skrebitzky and Bibikova, 1936[1]; Kirkman, 1937) and it was expected that *Larus atricilla* would be found to agree with the latter species, which it resembles to a considerable degree. Our experiments revealed, however, that the adequate stimulus for incubation is not the same in *L. atricilla* as in other species of the genus. The present paper embodies an account of our experiments which brought to light these differences.

It should be stated at the outset that since we were dealing with wild birds it has been impossible to determine how much of the incubation responses are learned and how much innate. This same deficiency is found, however, in all previous work with wild birds. Only when birds breeding for the first time have their eggs removed at the moment of laying will a situation be available for adequately testing innate behavior. Nevertheless, while fully realizing the limitations of this study, it is of interest to determine the adequate stimulus for brooding behavior in a gull not previously investigated because we gain information as to the kinds of sensory data that are significant in the brooding life of this species. Objects in the *Umwelt* of a bird have different valence, in the sense of Russell (1938), and a bird's point of view in regard to what may be significant is often very different from our own. This study shows that the constellation of significant sensory data varies from species to species within the genus *Larus*.

THE COLONY

Our observations and experiments were made in a colony of over 500 Laughing Gulls at Stone Harbor, New Jersey, during May and June, 1938.

[1] We are indebted to Professor K. S. Lashley for the loan of a reprint of this paper which we credit here to the investigators instead of to Borovski, the director, as Lashley (1938) has done.

Two rectangular blinds were covered with heavy duck and placed in two different parts of the colony. Although the authors worked separately in the two blinds they frequently conferred and in this way carried out a planned series of experiments. Mr. R. P. Allen and Mr. J. K. Potter were of assistance in locating the colony and Mr. L. Walsh in preparing the blinds. Assistance in the preparation of these materials was furnished by the personnel of Works Progress Administration Official Project No. 465-97-3-67. The eggs which served as models for our artificial eggs were borrowed from the Department of Ornithology of the American Museum.

RELATIVE ATTRACTIVENESS OF THE INCENTIVES INVOLVED

Previous workers have recognized that the adequate stimulus for incubation may emanate from (a) the nesting site, (b) the nest, (c) the eggs, or (d) from some combination of these elements. We have attempted to determine the relative importance of these different factors by introducing them singly or in different combinations opposed to other single or combined factors. For example, if we place an empty nest on one side of the old nest site and a clutch of eggs on the other side and the bird when returning to the nest area settles at once upon the eggs, we may assume that the eggs are a more effective source of attraction than either a nest or a nest site.

We have performed a series of experiments which are indicated diagrammatically in Text-figure 1. The opposing incentives are indicated along the top and the left-hand side of the figure. By following down and across any pair of incentives on the chart the result obtained with this combination is indicated by the arrow. That is, the bird selected the incentive toward which the arrow points. The number of arrows in any square indicates the number of times the experiment was performed on different birds. Dotted arrows indicate inferred results, as these combinations were not tested. Cross-hatched squares indicate impossible combinations. In every case the arrow indicates merely the first response to the experimental situation. This is presumably a response to visual cues for the results of the whole series are consistent even when two sets of eggs or two nests were used in various combinations, thus balancing the odor of the nest or eggs. After the bird has made a selection, tactile cues may modify the response. These later adjustments are not indicated on the chart.

The chart (Text-figure 1) fails also to give the distances between the two incentives. Since this is a very important factor, the data given in the chart may be repeated in table form and the distances involved, together with some supplementary remarks, added.

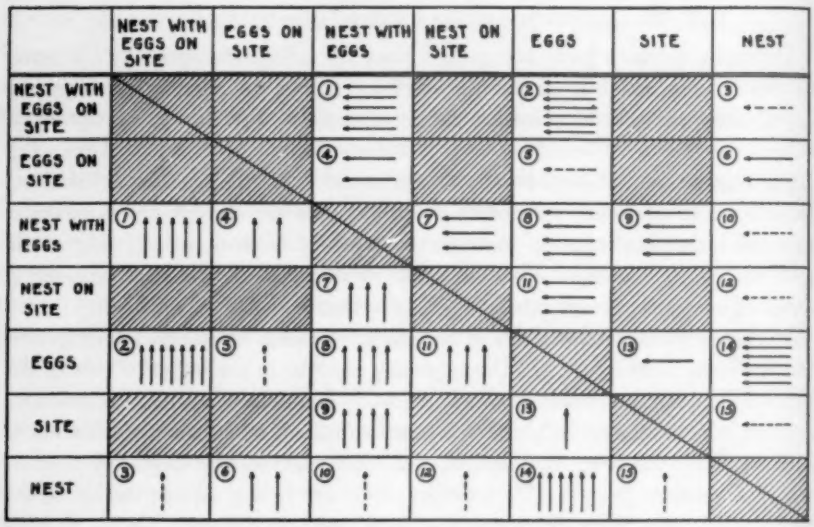
Experiment 1 (Square 1)

Conditions: Nest and eggs on site vs. nest with eggs.
Distance: 12 inches in four cases; 18 inches in one case.

Result: Bird sits on nest with eggs on site. The experiment was varied once by placing the original eggs in the extra nest, and the foreign eggs in the original nest; and once, by placing the extra nest with eggs on the site, and the original nest with eggs 12 inches away.

Experiment 2 (Square 2)

Conditions: Nest and eggs on site vs. eggs.
Distance: 1 and 12 inches, respectively.



TEXT-FIG. 1.—Diagrammatic representation of the Laughing Gull's response to elements in the nest situation.

Result: Bird sits on nest and eggs on site. Number of eggs outside nest varies. (Described in detail in Experiment 13.)

Experiment 3 (Square 4)

Conditions: Eggs on site vs. nest with eggs.
Distance: 12 inches.
Result: Bird sits on eggs on site. In both cases, the bird hesitated over an hour before settling.

Experiment 4 (Square 6)

Conditions: Eggs on site vs. nest.
Distance: 12 inches.

Result: Bird sits on eggs on site; hollows out crude nest around eggs when it incubates.

Experiment 5 (Square 7)

Conditions: Nest with eggs vs. nest on site.

Distance: Once, 12 inches; once, 18 inches; once, 20 inches.

Result: Bird sits on nest with eggs. In one case, hesitation was considerable; the bird, after having chosen the nest with eggs, went over to and sat on nest on site, twice, for a few seconds each time, but soon appeared uncomfortable and returned to the nest with eggs.

Experiment 6 (Square 8)

Conditions: Nest with eggs on one side of site, eggs on other.

Distance: 18 inches in one case, 24 inches in three cases, from nest with eggs to eggs.

Result: Bird sits on nest with eggs. Choice made after considerable hesitation, but apparently without the bird's attention being directed toward the site.

Experiment 7 (Square 9)

Conditions: Nest with eggs vs. site.

Distance: 12 and 18 inches, respectively.

Result: Bird sits on nest with eggs.

Experiment 8 (Square 11)

Conditions: Nest on site vs. eggs.

Distance: 12 inches in two cases; 32 inches in another.

Result: When the eggs were 12 inches away, they were rolled into the nest within a few hours. When they were 32 inches away, the bird, after sitting uneasily on the nest for twenty minutes, went to the eggs and sat, but still appeared uneasy.

Experiment 9 (Square 13)

Conditions: Eggs vs. site.

Distance: 12 inches.

Result: Bird hesitates, sitting on site twice for a few seconds each time; finally settles on eggs.

Experiment 10 (Square 14)

Conditions: Eggs on one side of site, nest on other.

Distance: 14 and 36 inches, respectively.

Result: Bird sits on eggs. Amount of hesitation varies considerably. Reversing positions caused parent to incubate eggs in new position.

A study of the above data will reveal that the various incentives involved in the incubation response have been arranged in a descending order of attractiveness in the left-hand column of Text-figure 1. Only the site in this table is not adequately evaluated in regard to its attractiveness. This is because we cannot move the site. When we move the eggs farther from the site, the attractiveness of the site as compared with the eggs increases. The relative strength of nest and eggs, on the other hand, can be accurately compared because we can place *nest* and *eggs* at equal distances on either side of the site. But the relative strength of nest and site varies with the distance they are separated. Hence, the relative attractiveness stated in Text-figure 1 holds only for the distances employed in these tests.

Lashley (1915) and Goethe (1937) have shown that birds orient themselves by means of prominent physical features of their environment. Hence the relative distinctness of the site would vary in strength according to the relative conspicuousness of these objects. It is possible that in Experiment 9 the attractiveness at the site was at its extreme. At least the bird sat down twice on the site before directing its attention to the eggs. The first reaction may have been toward site but we have indicated it as eggs because the only persistent reaction was toward the eggs. We have not been able to consider persistent reaction as the criterion throughout this table because secondary tactile cues in many cases entered into the response to modify the primary reaction.

FURTHER ANALYSIS OF THE INCENTIVES INVOLVED

The above experiments shed little light on the essential qualities of the incentives for inducing the incubation response. Further experiments were therefore devised to reveal these qualities.

a) *Nest.*—As shown in Text-figure 1, the nest appears to be the least attractive of the three incentives involved in the incubation response. The fact that a nest with eggs is selected in preference to eggs alone indicates that the nest is, nevertheless, an incentive of some significance. The essential feature of a nest appears to be its hollow. For example, in Experiment 6 we found that when an original nest with eggs is placed on one side of a site and a set of eggs is placed on a flat platform of nesting material on the other side the bird selected the nest. Two experiments made this preference for a deeper nest clearer.

Experiment 11 a

Original, deep nest placed at one side of site; artificial, shallow one, at the other. Identical sets of eggs in the two.

Result: The bird returns, sits on the shallow nest, appears unsettled; finally after ten minutes, moves across to the deeper one. The positions of the nests were then reversed. The bird returned, sat on the shallow nest

(on the spot where the deep nest had been on the previous trial) but, after about ten seconds, moved to the deep one. This test was repeated three times. On each trial the bird did the same thing; it sat on the shallow nest on the spot where the deep one had been on the previous trial, then, after a few seconds, it moved to the deep nest.

The deeper nest, therefore, is more attractive to the bird than the shallow one. The bird did not learn to tell the nests apart at sight, but could do so, apparently, by touch. An interesting point is the quick learning of a nest position, which will be discussed later.

Experiment 11 b

Four Clapper Rail eggs in new, deep nest, 12 inches from site. Two gull eggs on original nest, *flattened out*, 12 inches on other side of site.

Result: Bird went directly to gull eggs, and brooded; then stood up, turned and walked to rail eggs (in deep nest) and sat down; remained three minutes, then stood up and went to the gull eggs, and settled down.

Here the gull seemed disturbed by the shallow nest, but on the other hand when it had tried the deeper nest found the small Clapper Rail eggs also inadequate.

b) *The Eggs.*—In the normal course of events there are two ways in which the gulls react to the eggs: by incubating those in the nest, and by rolling in those that have been dislodged from the nest. These two responses may be considered separately.

The reaction to normal eggs in the nest is incubation. This need not be considered further, except to mention that additions or subtractions of eggs had no effect on the incubating reaction so long as the nest was not emptied. In striking contrast the rolling reaction may be affected by several factors: the number of eggs outside the nest, their distance from the nest and whether or not the nest is empty. The importance of these factors in the case of the Laughing Gull was shown by a series of experiments.

Experiment 12

All eggs removed from the nest. Normal eggs placed outside the nest.

Outside Nest	*Result*
a. 3 eggs, 2 inches from rim	2 eggs rolled in
b. Full clutch, 12 inches from rim—See Experiment 8	Eggs rolled in
c. Full clutch, 32 inches from rim—See Experiment 8	See Experiment 8

Experiment 13

Eggs placed outside a nest with eggs in it.

In Nest	*Outside Nest*	*Result*
a. 3 eggs	3 eggs, at 12 inches, 2 inches, and 1 inch from rim	None rolled during observation
b. 1 egg	1 egg, 1 inch from rim	None rolled during observation
c. 1 egg	3 eggs, at 2 inches, 2 at 6 inches, and 2 at 10 inches	None rolled during observation
d. 1 egg	3 eggs just outside rim	2 rolled during observation
e. 2 eggs	6 eggs just outside rim	3 rolled during observation
f. 2 eggs	5 eggs, 2 inches from rim	1 rolled during observation
g. 1 egg	3 eggs, 1 inch from rim	2 rolled during observation

These experiments are too few to give clear-cut results. Nevertheless, they indicate certain tendencies. First, if there are no eggs in the nest the tendency to roll back displaced eggs is much greater than if eggs are present. Second, the tendency is greater the nearer the eggs are to the nest. Third, the greater the number of eggs available the stronger will be the reaction. The distance of the eggs from the nest modifies the result. If the nest is empty, eggs will usually be rolled from at least 12 inches away. If there are already eggs in the nest, eggs will not be rolled in from distances more than two or three inches from the edge of the nest. Lastly, there must be at least three eggs available for rolling (unless the eggs are actually on the rim of the nest). These conclusions apply only for periods of two hours following the disturbance. It is possible that with long periods eggs ignored at first would be later rolled back to the nest.

Eggs may be attractive to gulls because of their color, form, hardness, odor, or a combination of qualities. Following the lead of previous workers with other species of gulls we have attempted to determine the adequate stimuli for eggs to be incubated.

First, the original nest was removed and two identical artificial nests placed in juxtaposition, half on and half off the original site. A clutch of typical eggs is then placed in one nest and a clutch of artificially colored eggs in the other. If the bird chooses the normal eggs consistently, it is concluded that it can distinguish between them and that the normal color is more attractive than the artificially colored ones. In each experiment the position of the clutch is reversed after the choice and the bird given another chance to choose. This eliminates any position habits. Each experiment thus represents two trials.

Experiment 14

Double nest; normal clutch in one, artificially colored eggs in the other.

Various controls were employed in the experiments. In some trials, eggs laid by birds other than the owners of the nest were utilized, thus eliminating the possibility that the bird's selection was based on the recognition

of its own eggs. In other trials, the two clutches were made up half from each nest, thus balancing a recognition of individual eggs.

	Total Number of Tests	*Alternative to Gull Eggs*	*Choice*
a.	6	Artificial eggs closely resembling original eggs in color and pattern	Normal eggs
b.	2	Yellow-spotted gull eggs	Normal eggs
c.	6	Blue-spotted gull eggs	Normal eggs
d.	4	Red-spotted gull eggs	Normal eggs
e.	2	Clapper Rail eggs	Normal eggs
f.	4	Lighter gull eggs	Bird hesitated; finally sat on light eggs and rolled its own eggs in with them.

The artificial eggs of Experiment 14a were made exactly the same size and approximately the same weight as genuine eggs. Size is thus eliminated as a factor. Weight can have no bearing on a selection which is made on the basis of visual cues. The surfaces of these plaster of Paris substitutes for eggs were varnished and later painted with oil colors. Number was controlled in two cases by making the artificial clutch of the same number as the original clutch while the alternative set of genuine eggs was in one case, one over, in the other case, one under, the number of eggs that the bird had been incubating.

It is apparent that the rejection of the artificial eggs which so closely resembled normal eggs in color must have been due to some characteristic of color or texture that we were unable to control. Since the birds failed to distinguish light from dark gull eggs, this rejection of the artificial eggs seemed remarkable (Experiment 14f). It is also possible that odor may have played a rôle, but of this we have no information.

Kirkman (1937) found that his Black-headed Gulls, which would not be disturbed by gull eggs painted various colors including red, were disturbed by red wooden eggs of the same size and shape. This, again, may have been due to texture or odor. In order to control the factor of the odor of the oil colors, tests were made with lacquers of different colors with the results discussed below. When the eggs were painted the colors were approximately Flaming Maple red, Bluebird blue and Cadmium yellow of Maerz and Paul (1930). In this series of experiments artificially colored gulls' eggs were introduced into the nests of brooding birds and their reaction to the situation was noted.

Experiment 15

Some eggs of a clutch painted.

a. With blue spots (lacquer). Two eggs in nest; one painted.

b. With yellow spots (lacquer). Three eggs in nest; one painted.

c. Completely red (lacquer). Three eggs in nest; two painted.

d. Cross-banded with red (oils). Three eggs in nest; two painted.

Result: In a, b, and c, bird sat, after more or less hesitation. Hesitation greatest in c (red). In d, one red egg was found thrown out of the nest next day and the nest was abandoned. The bird had previously shown fear of the blind, which was only seven feet from the nest, but there is little doubt that it returned and removed the egg.

Experiment 16

All eggs in clutch painted.

a. Completely blue (lacquer). Experiment repeated twice on different birds.

b. Completely yellow (lacquer). Repeated twice on different birds.

c. Completely red (lacquer).

Result: In a, the bird sat with slight hesitation. In b, one bird sat after slight hesitation, the other returned, stood at nest, but did not sit during twenty minutes of observation. In c, the bird was not seen for the rest of the day, but was found sitting next morning.

Experiment 17

One set of normal eggs substituted for another.

a. Two very pale eggs substituted for two very dark ones.

b. Two very dark greenish eggs substituted for one pale and one dark one.

c. Two very dark brown eggs substituted for two very light ones.

In every case the number of introduced eggs was the same as that of the original clutch.

Result: All birds incubated without hesitation.

It may be added that there was some variation in the responses of any one bird, as well as among the responses of different birds. The experiments clearly show, however, that red is most disturbing, blue much less so. The experiments with yellow are not clear, but suggest that the disturbance caused by it is intermediate between blue and red. Further tests were therefore devised to test the disturbing effect of artificially coloring a gull's egg.

It has been shown above (Experiment 1) that a Laughing Gull, given a normal nest and eggs on the site, will not incubate eggs in an extra nest off the site. A nest with eggs offers some attraction to the gull, but a nest with eggs on the site offers considerably more. If coloring the eggs renders them less attractive, the gull presented with colored eggs on the site and uncolored eggs in a nest off the site should select the latter. We have therefore tested a series of gulls in such a double nest situation.

Experiment 18

Two nests, one on the site, one off the site.

Contents Nest on site	*Distance Nest off site*	*Remarks*	*Reaction*
a. Red-spotted	20 inches	No other nest in 3 feet	Lands, stands at original nest, walks to extra nest, sits, walks back to original and returns. After thirty minutes, finally incubates red-spotted eggs on site.
b. Red	18 inches	No other nest in 2 feet	Sits on original ten minutes, starts to turn eggs; is immediately disturbed, alternates between nests, etc.; settles on red eggs on site after two hours.
c. Yellow	12 inches	Repeated twice on different birds	As in a.
d. 1 blue, 1 yellow	14 inches		Next day only normal eggs off site are warm.
e. Yellow	24 inches	(See Note 1)	Bird sits at once on normal eggs off site.
f. Red	30 inches	Nest in 6-ft. open site	Bird stands over red eggs ten minutes, then walks to normal eggs and sits; flies off. Returns and repeats (four times in one hour); sits on red eggs the fifth time; incubates seven minutes, then frightened off; returns at once to red eggs.
g. Yellow	30 inches		Stands over eggs on site, but does not incubate. Shows no interest in nest thirty inches away. No record of bird sitting.
h. Yellow	32 inches	(See Note 1)	Sits on yellow eggs.

Note 1.—When the positions of the eggs were reversed, the bird sat on the normal eggs on the site.

The disturbance caused by the abnormal colors is clear. If the eggs in the nest on the site had been normal, the birds would have paid no attention to the extra nest. In eight experiments only two birds sat on the artificially colored eggs on the site without first sitting on the normal eggs off the site.

Of the three experiments where the nests were thirty inches or more apart, in only one did the bird notice the extra nest; in this experiment the nests were in a 6-foot open space in the grass. In the others, the nests were built on the grass. It is apparent that the tendency to move to an extra nest is less, the farther away it is from the site. There is obviously considerable individual variation, however, among different birds.

A further test of the disturbing effect of artificially coloring the eggs of a gull was made by studying the rolling reactions of gulls presented with such eggs.

Experiment 19

Artificially colored eggs outside an empty nest.

	Number	*Color*	*Distance*	*Reaction*
a.	2	Blue-spotted	10 inches	Rolled in after at least two hours.
b.	2	Red-spotted	12 inches	Bird sits nervously all afternoon without touching eggs; found rolled in next morning.
c.	2	1 normal, 1 blue	2 inches	Only normal egg rolled in.

Experiment 20

Artificially colored eggs outside a nest containing eggs.

	Number in nest	*Number outside*	*Color*	*Distance*	*Reaction*
a.	2	2	Red-spotted	On rim	Rolled in after at least one hour.
b.	1	3	Yellow	2 inches	None rolled in.
c.	1	5	3 red, 2 normal	On rim	None rolled in.
d.	2	3	Red	2 inches	None rolled in.
e.	1	4	1 red, 3 normal	Just over rim	Two of the normal eggs rolled in.

Artificial colors on the eggs have, therefore, a marked disturbing effect on the rolling reaction of the Laughing Gull. In Experiment 19c, the normal egg was rolled in, whereupon the situation became that of Experiment 20, and the blue egg was not rolled in. The rolling of colored eggs into empty nests always took much longer than with normal eggs. The only time colored eggs were rolled into a nest already containing eggs, they were actually on the rim of the nest at the beginning of the experiment (20a).

The question remained if the shape and texture of an egg had an influence on the incubation response of the Laughing Gull.

Experiment 21

Two lumpy eggs placed in a nest in place of the bird's clutch. These eggs are made by attaching (with rubber cement) two-thirds of a shell to the end of a normal egg and one-third of the same shell to the other egg of the clutch. There is a distinct edge where the two shells meet. This experiment was repeated twice, on different birds.

Result: The bird incubates the eggs; neither egg is disturbed.

This change in shape does not disturb the bird to the extent of interrupting incubation.

Experiment 22

Three eggs removed from the nest and replaced by one egg with a hole broken into one end.

Result: Bird returns but refuses to brood.

Experiment 23

All eggs in the nest covered with a layer of rubber cement. This experiment was repeated twice, on different birds.

Result: a.—Bird returns and touches eggs many times but does not incubate. After some time sits and broods for twenty minutes; then gets up and tries to move eggs, then flies away. Back in five minutes and tries to brood again. Finally settles down for thirty minutes. At this time many small sticks are stuck to the eggs and they are drier.

b.—Bird later found brooding.

The rubber cement, which dries very rapidly, was very disturbing to the birds at first, but they gradually became used to it. At first it is very soft and wet; it gradually becomes drier and harder. The gradual drying and hardening of the egg probably removes some of the source of the bird's disturbance (since it will brood eggs of abnormal shape more readily than these wet eggs); in addition, the bird's drive to brood may be overcoming its hesitation. It is not apparent how much of the change is due to either factor.

Experiment 24

Nest in low grass moved two feet to one side of the site and extra nest placed two feet to the other. Eggs in the original nest covered with sticky rubber cement.

Result: Parent goes to the foreign (normal) egg in foreign nest, after having inspected the original eggs. Broods only foreign eggs.

When the position of the nest is reversed, the bird follows the normal eggs to the other nest.

Experiment 25

Eggs in the nest covered with rubber cement, then bits of dry grass stubs stuck into the cement, giving the eggs a 'whiskered' appearance.

Result: Bird broods the eggs, but later throws out one of them.

The 'whiskered' eggs are apparently disturbing but not enough so to prevent the bird from sitting on them.

Experiment 26

Extra nest with normal eggs twelve inches away from nest on site. Of the eggs in the nest on the site, one has projecting teeth of dentist's cement, the other has 'whiskers' of long wood chips.

Result: Bird sits on site, seems disturbed, gets up and goes to extra nest. Keeps going back and forth, finally settles on the 'whiskered' eggs. Frightened off the nest, it goes through the same performance on its return.

Here the disturbance caused by 'whiskered' eggs is demonstrated in the same way as that caused by color (Experiment 18).

Evidence of Learned Behavior in Incubation

In the course of experimentation it became apparent that the birds could quickly become adjusted to new incubating situations. Experiments were therefore devised to test the extent to which place habits could be acquired in a short time. A bird was tested in two experimental situations and the influence of the first trial in modifying the response in the second determined.

Experiment 27

a.—Nest with three eggs moved twelve inches.

Result: Bird sits on it all day.

b.—Next day, the bird is still sitting. Another, similar nest with three eggs is placed on the site.

Result: The bird was extremely disturbed and did not settle down all afternoon. Next day, four eggs were found in the off-site nest, two in the on-site nest, but only the on-site nest was warm and only it was seen incubated thereafter.

This indicated that the bird first sat on the off-site nest but that the attraction of the nest on site was suffiicent to make it roll one egg into the off-site nest from it. Finally, the attraction of the site-nest induced the bird to return there, after which the four eggs in the extra nest were not moved. The bird was very much disturbed by the situation, which it would not have been if the first situation had not been experienced (Experiment 1).

Experiment 28

a.—Extra nest placed 18 inches from nest. Eggs from nest placed in extra nest.

Result: Bird sits on extra nest after some hesitation.

b.—After the bird has been brooding for six hours, an extra set of eggs is placed in the original nest in addition to those in the duplicate nest.

Result: Bird sits thirty minutes on duplicate, then gets up and goes to original nest. Still there, three hours later, when observations were discontinued. (Note: If the bird is presented with a nest with eggs on the site versus a nest with eggs off the site without any previous disturbance, it normally sits on the site without reacting at all to the extra nest with eggs—see Experiment 1.)

Experiment 29

a.—Nest moved 18 inches with eggs.

Result: Sits on nest with eggs after some hesitation.

b.—After four hours of incubation, grass at original site flattened, set of eggs put there.

Result: Bird lands, stands hesitating between the two spots, flies off; does this four times, then settles on nest with eggs. (It would normally sit on eggs on site—Experiment 3.)

c.—Eggs on original site, placed in nest (still on original site).

Result: Bird sits on off-site nest all afternoon, but nest on site is the only one warm next morning and is the only one seen incubated thereafter. (See note, Experiment 28.)

Experiment 30

a.—Nest moved 12 inches, eggs left on site.

Result: Bird sits on eggs.

b.—Eggs added to nest (in addition to those on site).

Result: After hesitating and alternating for over three hours, the bird finally settles on nest. Next morning, nest warm, eggs on site slightly so; only the nest seen incubated that day in the morning but it is deserted for the site later in the day; only the site seen incubated thereafter. (Note: If the bird is presented with eggs on site versus nest with eggs, without any previous disturbance, it goes to the eggs on site—see Experiment 3.)

Experiment 31

a.—Nest and eggs each 12 inches from site, on opposite sides.

Result: Bird spends over one hour going from nest to eggs and back. It sits on nest for two minutes, appears uncomfortable, gets up and walks to the eggs, sits, gets up in thirty seconds, walks to nest, etc. Finally settles on eggs and scoops out a hollow under them.

b.—Set of eggs added to nest.

Result: Bird sits on nest with eggs with practically no hesitation. (Normal; see Experiment 6.)

c.—Nest with no eggs placed on site.

Result: Bird hesitates 30 minutes between the two nests; finally sits on eggs (walking past site to do so); gets up after 30 minutes, walks past site to nest with eggs (off site); settles there.

d.—Eggs placed in nest on site.

Result: Bird sits on off-site nest with eggs, after 45 minutes hesitation, for four hours, then moves to nest and eggs on site. Sits there all the rest of the afternoon with occasional standing up and looking at the off-site nest. (See note, Experiment 28.)

Experiment 32

a.—Nest moved 12 inches, eggs left on site.

Result: Bird sits on eggs, hollows out nest around them.

b.—Eggs moved to moved original nest; hollowed-out new nest left in position.

Result: Bird sits on nest with eggs.

c.—Eggs (extra) added to the new nest on site.

Result: Bird sits on nest and eggs off site. (See note, Experiment 28.)

DISCUSSION

The different species of gulls apparently exhibit marked difference in their tendency to roll back displaced eggs into the nest. *Larus ridibundus*, according to Skrebitzky and Bibikova (1936), will roll eggs back into its empty nest from distances of at least a meter. If there are some eggs in the nest, this species will roll them back only from distances less than 15 cm. away. Kirkman (1937) has shown in this species that if the nest is empty all the eggs will be rolled back from a distance of 20 cm. but that only 80 per cent will be rolled back if there are some eggs in the nest. *L. argentatus*, which builds a more elaborate nest than either *L. ridibundus* or *L. atricilla*, is more attracted by the nest than are these species. Tinbergen (1936a) found that if its eggs are placed outside the nest, the bird tends to sit on the empty nest, instead of on the displaced eggs. Steinbacher (1937) and Goethe (1937) agree with Tinbergen that the Herring Gull does not often roll its eggs back into the nest. There is, however, considerable variation of this tendency within this species. Goethe (1937) found that if the eggs are placed more than 20 cm. from the nest the bird will sit on the empty nest. Steinbacher secured different results. At 20 cm., three clutches which he experimented with had a new nest built around them, while four other clutches were rolled back into the empty nest. At a distance of 40 cm. from the nest, three clutches were rolled back, one deserted and six accepted on the new site. At one meter, 29 clutches were accepted at this distance from the nest, four were rolled back and 34 were deserted. This discrepancy between the findings of Goethe and Steinbacher may be due to the fact that the experiments were performed with gulls at different stages of incubation.

It is apparent that gulls and terns building shallow nests roll their displaced eggs more than do birds building deeper nests. Goethe (1937) states that *L. argentatus* very rarely knocks an egg out of the nest when leaving it. Kirkman (1931) finds that, in *L. ridibundus*, this happens "not infrequently." We found no certain case of this in *L. atricilla*, although displaced eggs were seen four or five times. Hence, gulls which build shallow nests have greater opportunities of rolling back displaced eggs than

do species building deep nests. Just as Herring Gulls which build deep nests, tend to ignore displaced eggs, so passerine birds, which build even more elaborate nests, ignore their young when these are thrown beyond the rim of the nest by a parasitic cuckoo (Chance, 1922). In both Herring Gull and passerine bird, the extensive work which has gone into the nest construction seems to take the attention of the bird away from the biologically more significant object.

The different results secured by different workers with a single species of gull may be due in some cases to different methods of testing. For example, Skrebitzky and Bibikova (1936) placed a series of eggs and nests of *L. ridibundus* on opposite sides of the original nest site and 20 cm. from it. In 85 per cent of the cases (number not stated) the birds sat on the site and eventually rolled the eggs to it. In the other 15 per cent of the cases they sat on the eggs and built a new nest around them. Kirkman (1937) placed the nest, eggs and site at the respective apices of an equilateral triangle. Sixty per cent of a series of twenty birds sat on the eggs and built a new nest around them. In 10 per cent of the cases they rolled the eggs to the site and in 5 per cent of the cases they rolled the eggs to the nest. In the remaining 25 per cent of the cases they sat on the empty nest. In brief, Kirkman, unlike Skrebitzky and Bibikova, had proved that the nest was of some attraction to the parent birds of *L. ridibundus*. The difference in the results is probably due to the fact that the strength of the attractions of nest, eggs and site, respectively, in the two experiments is different because of the arrangement of the incentives. At least a gull standing in the center of a triangle having 18-inch sides would have its head only a few inches from the nest.

In some cases the differences between the results secured by different workers may be due to differences in the activity of other birds in the immediate vicinity. For example, Skrebitzky and Bibikova found that if the nest with its eggs of *L. ridibundus* is moved from 20 cm. to one meter away from the site the bird is attracted more by the nest and eggs than the site and broods in the new location. Kirkman, however, noted that if a nest of this species is moved close to that of another gull, the owner of the first nest will move its eggs out of the nest and back to the site in spite of the fact that the bird's first reaction is the same as that reported by Skrebitzky and Bibikova.

When due consideration is given to the different methods that have been employed in studying the reactions of gulls to the several factors in the nest situation, it still seems that there are constant species differences. The Herring Gull is not only more attracted by its nest than is the European Black-headed Gull but it seems to be more attracted by the nest site. Goethe (1937), for example, found in one case that when he moved the nest

and eggs of a Herring Gull 28 cm. the bird ate the eggs. Skrebitzky and Bibikova (1936) assumed that the site was more attractive than the nest in the case of *L. ridibundus* because when they moved the nest of this species 20 cm., leaving the eggs on the site, the bird incubated the eggs and hollowed out a new nest around them. It is probable, however, that the parent birds were in this case responding to the eggs and not to the site at all. If the eggs are placed in the nest instead of on the site, in the otherwise same situation, the bird sits on the nest. Tinbergen (1936), on the other hand, found that if the eggs of the Herring Gull are placed only a short distance from the site while the empty nest is left on the site, the parent will brood them only if a nest form is built under them. It may, therefore, be concluded that the nest hollow itself is attractive to the Herring Gull, irrespective of its relation to the site.

It was shown above that artificially coloring the eggs of a Laughing Gull would seriously modify the incubation behavior of a parent bird. The Laughing Gull builds crude nests and similarly the terns, which build simple nests, are disturbed by a change in color of their eggs. Dircksen (1932) found that in the case of *Sterna sandvicensis* the substitution of fowl eggs, colored either red or blue or left white, caused considerable hesitation in brooding. Eventually the parent would settle on the nest except in some cases when red eggs were employed. Marples and Marples (1934), experimenting with *S. hirundo*, also found that red or blue eggs were definitely disturbing, although they were usually later accepted. Similarly coloring the eggs of *S. fuscata* caused a marked hesitation (Watson, 1908). The Noddy Tern, *Anous stolidus*, unlike these other terns, builds well-formed nests in bushes and Watson found that coloring the eggs produced little change in the behavior of the parents. The extreme stage of sensitivity to slight differences in the eggs is found in the Atlantic Murre as reported by R. A. Johnson (personal communication). This species builds no nest, laying eggs on the surface of ledges on the rocky cliffs of its nesting colonies. When Johnson interchanged the eggs of three individuals sitting close together, the birds, on their return, each rolled its own egg back to the original site and sat on it, thus restoring the situation to what it was before the experimenter disturbed it.

From such data as the above we might expect that the gulls which build poor nests would be very sensitive to changes in the color of their eggs while, conversely, the better nest builders would ignore these changes. These correlations do not seem to work out in detail. As shown above, *L. atricilla*, a poor nest builder, is very sensitive. *L. ridibundus*, another poor nest builder, according to Skrebitzky and Bibikova, and Kirkman, will accept eggs of a great variety of colors without hesitation. On the other hand, a better nest builder, *Larus argentatus*, hesitates before yellow, green or blue

eggs (Goethe, 1937) but most birds would brood them. When normal eggs were placed with blue eggs on the edge of the nest only the normal eggs were rolled into the nest. In the double nest situation (two nests on the original site) with the normal eggs in one nest and colored eggs in the other, Booy and Tinbergen (1937) failed to secure a marked preference for the normal eggs. Only red eggs were markedly disturbing in this situation and in the single nests. This, therefore, is a clear-cut difference between these two species of gulls and, oddly, the better nest builder is the more disturbed by the red eggs.

In view of our experiments with *L. atricilla*, it becomes even more apparent that species differ in the attention they pay to the details of the egg regardless of the elaborateness of the nest. *L. atricilla* in a double nest situation can distinguish its own eggs from models that resemble them closely. Similarly, the North American Cowbird, *Molothrus a. ater*, parasitizes successfully many species of passerine birds but the European Cuckoo, *Cuculus canorus*, apparently meets with greater resistance from its hosts. Rensch (1925) found that in the case of several European passerines complete clutches of eggs painted red were accepted far more often than single red eggs introduced into a nest of normal eggs. Into one nest of *Sylvia borin*, from which the eggs had been removed, Rensch placed the same number of *Sylvia curruca* eggs. The latter eggs were accepted but when later the parent laid a single egg this was rejected, apparently because it was unlike the other eggs. It is, therefore, not surprising that the cuckoos that parasitize *Sylvia borin* must lay eggs which resemble the eggs of that species closely, as Makatsch (1937) has shown. All this attention to discordant eggs in the clutch is far more precise than the behavior of gulls even though the nests of passerine birds are more elaborate.

Although passerine birds are disturbed by changes in the clutch as a whole, other birds seem to pay attention to details in the eggs *per se*. The Ringed Plover, *Charadrius hiaticula*, will accept spotted eggs of a variety of colors but will fail to incubate unspotted eggs (Koehler and Zagarus, 1937). Although the eggs of *Larus atricilla* are spotted, the gulls will incubate eggs uniformly lacquered yellow or blue. Hence the species respond to different cues, whether these are learned or innate.

Tinbergen (1936) found that a tern, which had incubated eggs in a new location for only three minutes, returned to this site when the eggs were moved back to the original nest site. We have shown above that *L. atricilla* quickly learned a new site in which its eggs were placed. Although it is impossible to tell from the data available on gulls how much of the incubation behavior is learned and how much innate, it is interesting that two species as closely allied as *L. atricilla* and *L. ridibundus* and building essentially similar nests should differ so considerably in their reaction to the

eggs. *L. ridibundus* will roll and incubate eggs of many different colors; *L. atricilla* is disturbed by foreign colors, especially red, and the intensity of its egg-retrieving behavior is greatly lessened by these colors.

Within the species, however, there are variations, some of which may be correlated with sex. Skrebitzky and Bibikova (1936) and Kirkman (1937) found that *L. ridibundus* would incubate objects having a great variety of shape and form. Our experiments with *L. atricilla* were in agreement so far as they went. Any object having a sharp edge or corner was removed from the nest unless it was small and could be worked into the nest. Booy and Tinbergen (1937) found that *L. argentatus* would incubate sharp-edged eggs (parallelopipeds) even when the normal eggs were adjacent to them. In the same species Goethe (1937) found that males hesitate or refuse to incubate polyhedral eggs. The female, however, although hesitant is less 'critical' than the male and accepts them sooner.

Text-figure 1 shows the reactions of the birds to visual cues, namely, the birds' first reactions, based on what they see. The subsequent behavior may be affected by tactile cues. In Experiment 8, where a bird sat on a spot where there were no eggs, the birds were seen to become steadily more uneasy; finally the birds, when the eggs were 12 inches from the nest, rolled them in; when they were 32 inches away, the bird, after brooding the empty nest twenty minutes, went to the eggs.

The marked difference between the egg-rolling behavior of birds incubating eggs and that of those sitting on empty nests is apparently a result of difference in tactile stimuli. In *L. argentatus* and *L. ridibundus* also, birds on nests with eggs are less persistent in egg rolling than those on empty nests. Our experiments are not sufficiently extensive to show conclusively whether this difference is an 'all-or-none' one, or whether a bird with, for example, two eggs would roll more than one with three eggs. Judging from Experiment 13e, in which the bird rolled three eggs into a nest already containing two, as well as from the remarkable persistence of *L. ridibundus*, which will roll in enough to make a total as high as nine (Kirkman, 1937), differences in the number of eggs in the nest (within the normal range) would presumably not modify the reaction.

The apparent inconsistency in Experiment 14, where the birds were shown to be able to distinguish artificial eggs closely resembling normal eggs in size, shape and color from the latter, but were unable to distinguish other gull eggs from their own even when they were distinctly different in tone and pattern, may have been due to either odor or tactile cues. Although workers with other species of gulls have shown the importance of tactile cues in certain situations, there is no clear evidence that olfactory cues enter into the response of any gull to its eggs.

The retrieving behavior of an incubating bird has been extensively

studied in the case of the Grey-lag Goose, *Anser anser*, by Lorenz and Tinbergen (1938). They find that only objects with an unbroken surface are rolled back into the nest. The retrieving movements in this species are far more stereotyped than in the case of the Ringed Plover as described by Koehler and Zagarus (1937). This species may use its wing, feet, breast or bill to move the egg. In other species, such as *Sterna fuscata* (Watson, 1908) or *Larus argentatus* (Tinbergen, 1936), the return of the egg to the nest site appears to be the result of the way the bird facing away from the nest site tucks the eggs under her breast feathers in settling upon it. Kirkman (1937), however, considers the reaction a definite attempt to restore the egg to the nest and this appears to be true in *L. atricilla* when the egg is not far from the nest. When the egg is far from the nest the rolling seems to be more accidental.

CONCLUSIONS

1. *Larus atricilla* is able to distinguish its own eggs from artificial eggs which resemble them closely in form and color. It fails to distinguish its own eggs from other Laughing Gull eggs which have a decidedly different color tone or pattern.

2. Incubating birds of this species will accept and incubate eggs of various colors when placed in the nest. Red causes more hesitancy than either blue or yellow and some individuals may remove red eggs from the nest. In this antipathy to red, *L. atricilla* differs conspicuously from *L. ridibundus*.

3. Artificially coloring the eggs will disturb the retrieving reaction to displaced eggs more than it will the brooding reactions. Merely marking the eggs with different colors will disturb the incubating reactions as experiments with double nests on the nest site show.

4. Broody Laughing Gulls are attracted by (a) the eggs, (b) the nest site, and (c) the nest. At short distances the attraction of the eggs is greatest, of the nest site less, and of the nest least. This order of attraction is different in species which build more elaborate nests.

5. The retrieving reaction toward displaced eggs is stronger when all the eggs have been removed from the nest. It is greater when the number of eggs outside the nest is larger. This reaction is also stronger the nearer the eggs are to the edge of the nest.

6. Broody Laughing Gulls are more attracted by deep nests than by shallow ones, but they distinguish between them only by settling down in them. The number of eggs in the nest does not seem to modify the response provided some eggs are present.

7. Eggs of abnormal shape will be incubated but not one having a hole punctured in it. Roughening the surface of the eggs by gluing small pieces of hay to them disturbs but does not prevent the incubation behavior. A

covering of soft, rubber cement, however, will inhibit the incubation behavior.

8. A Laughing Gull will learn a new position of the nest very quickly and return to this place after the nest has been returned to the original site.

9. In general, the more elaborate the nest the more a parent bird is attracted by it but different species of gulls having essentially similar nests may differ considerably in the degree of disturbance in their behavior that a modification of their eggs will produce.

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American Museum of Natural History
New York City

EGG VOLUMES AND INCUBATION PERIODS[1]

BY C. BROOKE WORTH

INTRODUCTION

IT is common knowledge that the eggs of large birds have, in general, a longer incubation period than those of small birds, but this appears often to be only the most general sort of rule, with many exceptions. The irregularity of the rule can be demonstrated easily by plotting several egg sizes (see below, 'Methods') against their incubation periods on a simple graph (Text-fig. 1).

METHODS

The approximate volume of an egg may be obtained from its average measurements by the formula for an ellipsoid:

$$V = \frac{\pi}{6} ab^2$$

where a is the long axis of the egg and b is the widest transverse axis. Egg measurements are subject to a maximum variability of 20 per cent (Fisher), but since longer eggs are usually narrower, the variability in volume is possibly not so great, whereas the use of *average* egg measurements undoubtedly gives a substantially correct value for average volumes.

An egg is not a true ellipsoid, since it is somewhat narrowed in the maternal oviduct. Among hens' eggs I found volumes by water displacement which were 15 per cent less than those calculated by the ellipsoid formula. On the basis of the following study I have concluded that this is a fairly representative correction for other eggs.

The table shows a list of: egg weights from Bergtold; the volumes calculated from these weights (using a constant specific gravity of 1.07 as in the hen); the volumes calculated by formula from average egg measurements; and the calculated volumes subjected to a correction of -15%. It will be seen that there is a general agreement between the egg-weight volume and the corrected-formula volume.

An examination of this table shows that:

(a) The Ostrich egg, which is more nearly spherical than most eggs, and whose two poles are symmetrical, is apparently more closely represented volumetrically by the uncorrected formula than any of the other eggs. This, however, is probably not true, since the specific gravity of an Ostrich egg is undoubtedly much higher than 1.07, and its volume is therefore less than

[1] Presented before the Delaware Valley Ornithological Club on February 3, 1938.

Species	Wt. (oz.)	Wt.-Vol. cu. in.	Form.-Vol. cu. in.	Form.-Vol. −15%, cu. in.
Ostrich	60	94.8	99.07	85.6
Western Robin (2)	.23	.362		
Eastern Robin (1)	.06	.095	.41	.351
Crow	.62	.956	1.34	1.15
Domestic Hen (4)	2.27	3.57	4.25	3.53
Common Tern (1)	.64	1.05	2.03	1.75
W. Mourning Dove (2)	.40	.63		
E. Mourning Dove (3)			.39	.34
Kingfisher	.45	.71	.84	.72
Screech Owl	.58	.92	1.15	.99
Kingbird	.15	.236	.26	.224

(1) Meyer; (2) Bergtold; (3) Forbush; (4) Worth.

that calculated in this way on the basis of its weight. I assume that the pyriform eggs of cliff-dwelling birds are least closely approximated by the formula; the correction in these cases should probably exceed −15%.

(b) The weights of the eggs of the Crow and Common Tern may have been taken after partial incubation had occurred, or else the eggs were smaller than the average for each species.

(c) The Mourning Dove's eggs, weighed by Bergtold (of Denver, Colorado), were undoubtedly of the western subspecies—a decidedly larger bird than *Zenaidura m. carolinensis*.

(d) The other cases come well within 10 per cent of agreement.

(e) The ellipsoid formula, less 15 per cent, therefore gives a fairly true estimate of egg volumes from their primary measurements among eggs of varying sizes and shapes.

Having explained the apparent exceptions to my own satisfaction, I have therefore calculated further egg volumes and corrected each one arbitrarily by −15 per cent, since what I needed for my study was simply a rough approximation to the true egg volume. It need scarcely be observed that, were sufficient egg weights of fresh eggs known, one would conduct such a study as this on egg weights in preference to volumes; or, better still, on the weight of the *contents* of the freshly laid eggs (minus their shells). It appears, however, that even as sketchy a volumetric approximation as this one yields information of sufficient validity to warrant its analysis.

Similarly I have used the average length of the reported incubation period for each species, though as Bergtold has suggested, it might have been better to use the minimum reported period; the latter course, however, would have necessitated the repudiation of many excellent authorities, and since it is quite possible for minimum periods to be reported erroneously, I thought it best to calculate an average period from all reasonable reports.

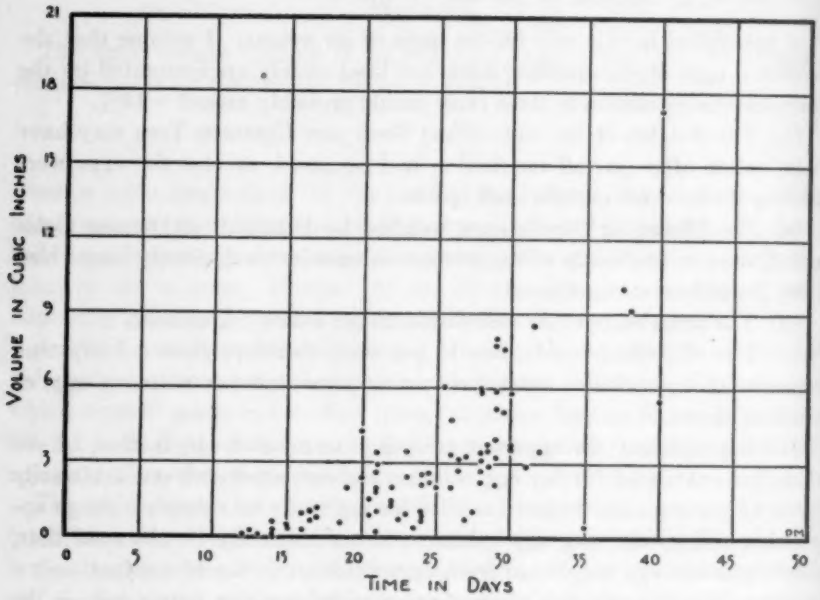
A signal handicap to this study is the lack of information on the incubation periods of very many birds, particularly among the non-passerine orders.

Finally I have, at a later point in the analysis, assigned to these birds an average clutch of eggs, calculating this from the common variation in numbers in the clutch, and disregarding the obviously extreme cases. Where it was possible to determine the usual number in a clutch, I used this figure in preference to the average number.

These various figures are presented in Tables 1 and 2.

Procedure

On examining Text-fig. 1, we find that its apparent irregularity is due to the simultaneous occurrence of two variables, viz., an egg of a given size



TEXT-FIG. 1.—Egg volumes plotted against incubation periods.

may have a variable incubation period, and an incubation period of a given duration may obtain among eggs of variable size.

A further cause of obscurity in Text-fig. 1 is that the range of variability among egg sizes, measured in cubic inches, extends through four logarithmic cycles (0.03 cu. in. to 85.9 cu. in.); if we include the Moas and *Aepyornis*, this variability extends through five cycles, whereas the incubation periods, measured in days, occur within one cycle (10 days to less than 100 days).

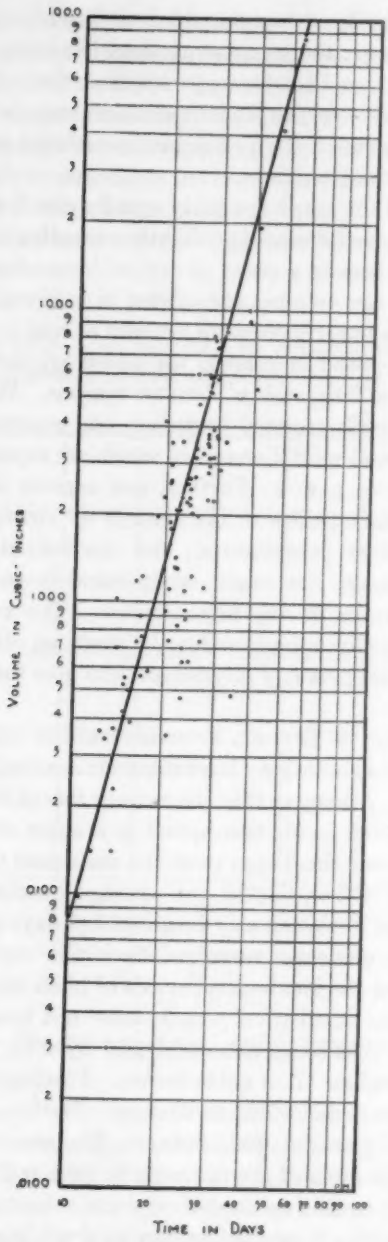
If we plot egg sizes from hummingbird to Ostrich against incubation periods on 'log-log' paper, the apparent random inconsistency of Text-fig. 1 is given a new face; it then becomes apparent that there is a fairly consistent relationship between volume and time which may be represented by a straight line drawn between the two points pertaining respectively to the Yellow Warbler and the Ostrich.

The other points of the graph are fairly equally distributed on either side of the line. The line itself has a slope slightly exceeding 4 : 1. This means, mathematically, that among a series of eggs of increasing size, the incubation periods and the egg volumes are related in a geometric ratio of a surprisingly high order; a linear increase of one unit of time is accompanied by a corresponding fourth-power increase in the added egg increment.

I call this revelation "surprising" for two reasons. When one considers the growth of a three-dimensional organism, one expects to find relationships between linear and solid dimensions which are expressed by the third, rather than the fourth, power. Further, one expects the actual eggshell surface to influence metabolism in the embryo by virtue of its limiting influence upon respiratory potentialities; and therefore it becomes conceivable that increase in egg size might easily stand in only a second-power relationship to increases in any linear factor. The explanation of this fourth-power relationship must therefore be made on other grounds, and I hereby invite embryologists and physiologists to give further consideration to the problem.

A further inspection of Text-fig. 2 reveals another relationship, namely, that eggs of the same volume may have different incubation periods in more than a random way. Assuming that the average line of the graph represents the average or expected incubation period in a series of eggs of increasing size, we find that among small eggs there is a maximum normal deviation of about four days on either side of the average incubation period, while among larger eggs the deviation may be about five days on either side of the average. Since the deviation usually falls within such limits, one may hazard a fair guess at the incubation periods of birds whose egg dimensions are known, but whose incubation periods have not been discovered. For example, the Great Auk's egg measured 4.67 by 2.91 inches (Chapman). Its volume was therefore 17.82 cubic inches. Plotting this in Text-fig. 2, we find an incubation period of about 39 days. The Great Auk's incubation period was therefore probably 39 ± 5 days. The question remains: which is the more likely direction of the deviation? Or is it likely that there was any deviation at all in this species?

Returning to Text-fig. 2 for the answers to these questions we find that many birds fall on the line, while others fall at varying distances on either side. I have prepared a list showing: (a) the species on the line itself or



TEXT-FIG. 2.—Logarithmic plotting of egg volumes against incubation periods.

within a day on either side of it; (b) all species further above and to the left of the line; and (c) all species further below and to the right of the line (Table 2).

The birds in the left-hand column of the table have incubation periods longer than the average. In the center column the periods may be accepted as the average. On the right the periods are shorter than the average. An examination of the groupings into which the species fall by this analysis shows a moderate degree of taxonomic overlapping, but at the same time a singular degree of ecological uniformity. First, the birds with a short incubation period (right-hand column) are chiefly species subject to predation or some other type of environmental onslaught. It will benefit them to hatch out their eggs with the greatest possible dispatch, for a bird a-wing is a less easy mark for a predator than an egg or a brooding parent. (Bergtold has also concluded that a shortened incubation period brings *benefit* to a species.) Thus no gulls occur in the left-hand column, and no terns except the Sooty Tern, a tropical species. Among these beach-breeding birds the threat of high tides may act as the stimulus for accelerated incubation, inasmuch as the young are hatched in a precocious state, and the egg stage is the chief danger period. Second, the birds of prey tend to be concentrated in the left-hand column. There are many in the center column, but none at all on the right. These altricial birds, having adequate means of offense and defense, have not felt the press of embryonic speed—there has been less premium on rapid incubation and fledging during centuries of hawk and owl evolution than there has been among other orders. (Is it more than coincidence that the Ptarmigan, White Gyrfalcon, and Snowy Owl—each one an albinistic form—all occur in the left-hand column? There seems to be a preponderance of boreal forms in this group.) Third, the birds in the left-hand column which are subject to predation compensate for their long incubation periods by laying large clutches of eggs (Ingersoll states that the number of eggs laid by a species is in direct ratio to the dangers which it ordinarily encounters). No matter how many of their clutches are destroyed, a single successful one will result in bringing forth a distinct addition to the population.

The group of the center or 'average' column contains members of practically all the taxonomic divisions. Possibly there is a greater concentration of highly specialized forms here than elsewhere (viz., woodcock, osprey, oystercatcher, nighthawk, kingfisher, etc.), though otherwise it is generally characterized as an 'overlapping' group. The highly specialized birds may perhaps be thought of as finding their specialization a mixed benefit, bringing with its advantages also distinct limitations which closely balance each other, so that incubation time is in the end neither accelerated nor retarded. The birds in the right-hand column which exhibit both increased incubation

speed *and* large clutches of eggs are compensating *doubly* for some environmental adversity whose exact nature it would be most interesting to investigate. The Redhead, in fact, is having difficulty in maintaining its status in eastern United States, despite its rapidly incubated clutch of 12.5 eggs. My ornithological friends blame the bird's failure to adapt itself to sportsmen and fire-arms, and no doubt this stupidity extends to other phases of its conduct. If that is so, it has been subject to environmental inroads over a long period of time and has saved itself from extinction only by the double compensation which we have noted.

Therefore in calculating the incubation periods of extinct birds, or of modern birds whose incubation periods are unknown, one may, on ecological grounds, and to a lesser extent on taxonomic grounds, suspect that the deviation, if any, from the calculated average incubation time is positive or negative, depending on the habits of birds occupying similar niches and the type of deviation which such birds exhibit. With this in mind, I think it probable that the Great Auk's egg hatched in 44 days, the deviation from 39 days being in the direction of delayed hatching (see Table 2 for isolated boreal or Antarctic island birds laying a single egg; they occur principally in the left-hand column, i.e., Wilson's Petrel, Leach's Petrel, Fulmar, Gannet, and Dovekie).

A further examination of Text-fig. 2 shows that there are two cases in which the incubation period falls *behind* the expected limit of deviation from the average. The Fulmar is the more noteworthy example of this, while the Gannet shows a less abnormal condition. The cause for such long incubation periods is obscure to me, though it may be the result of long isolation from predation or other adversities. If these incubation periods are really as markedly retarded as this, the Fulmar and the Gannet would be interesting subjects for physiological study. But there is a possibility that the incubation period has been wrongly observed and recorded in each case. In checking these aberrant data I find that Evans stands alone in ascribing to the Fulmar an incubation period of "about a month" instead of 55 days. Evans's estimate falls exactly on the line! So far as the Gannet is concerned, the minimum reported incubation period is 39 days, which still gives it an extraordinary deviation beyond the expected limit of retardation. To come within the limits at all, its incubation period should not exceed 33 days. It would be well for field ornithologists to check up on both these birds again, noticing especially whether the Gannet regularly *suspends* incubation, when the eggs would become chilled and their hatching delayed. On the other hand the Caspian Tern offers an extreme case of accelerated embryonic growth, and one wonders at the accuracy of the reported incubation period (20 days).

In the case of the Domestic Fowl, I asked a housewife to select a few

'average-sized' eggs; I calculated their average volume as 3.47 cubic inches. The incubation period, 21 days, again represents an acceleration of the embryonic growth rate. Under domestication this bird has been bred selectively for the production of larger eggs, for the volume of the Red Jungle Fowl's egg is only 1.56 cubic inches—less than one-half of the figure for the domestic bird (Beebe). On the other hand no artificial selection has been practiced upon the fowl's incubation period; no change of incubation period has been noted among any of man's domesticated birds (Bergtold), for the time element is exactly the same as that of their wild congeners. Since the incubation period is a constant specific character in the fowl, the rate of embryonic growth must have been raised automatically by the artificial enlargement of the egg under domestication. We may test this startling hypothesis by plotting the Red Jungle Fowl's egg on Text-fig. 2. A volume of 1.56 cubic inches and an incubation period of 21 days fall exactly upon the line, while the domestic bird's egg falls far from it. This proves that under domestication the egg has not only been enlarged, but that the growth rate of its embryo has been accelerated as well. This means that the domesticated egg material must experience a more rapid series of cell divisions than did the egg material of the wild ancestors, for we believe that a large animal consists of more cells than does a small one. Byerly, however, has been unable to detect different rates of cell cleavages among breeds of Domestic Fowl of various sizes. It is also puzzling that the basal metabolic rate is lower in large animals than it is in small ones. Could it be, then, that a greater degree of mitotic activity can obtain in the presence of a lower metabolic rate?

There may be a new clue in this query to the decadent tendencies so frequently found among the giant forms of an evolutionary series of animals. Perhaps their tissues, the seat of a constantly increasing cellular activity, are starved through the equally increasing metabolic inertia which accompanies great physical enlargement. Decadence, so unexpected in giant forms when we consider the potentialities for integrated activity among these great multitudes of cells, is therefore a function of the decrease of the animal's surface area relative to its bulk. Decadence, on the other hand, is not a consequence of cellular degeneracy, the cells being more active than ever before and being overwhelmed finally by sheer gigantismal suffocation.

But to return to our primary data: a mathematical analysis of it yields the following relationship between egg volumes and incubation periods:

$$V = .0063\left(\frac{1000\ V}{T}\right)^{1.30}$$

Let us test this formula by calculating the probable incubation period of any egg simply from its dimensions. The following case is an example,

selected at random from the list of birds which fall on the line of Text-fig. 2, and for which, therefore, no ecological correction need be made.

The Black Vulture's egg averages 3.15 by 2.02 inches in its diameters. What is its incubation period?

$$V = .85\left(\frac{\pi}{6}ab^2\right) = 5.81 \text{ cu. in.}$$

$$5.81 = .0063\left(\frac{5810}{T}\right)^{1.30}$$

$$\log 5.81 = 1.30 \log\left(\frac{5810}{T}\right) + \bar{3}.80$$

$$.76 = 1.30 \log\left(\frac{5810}{T}\right) - 2.20$$

$$1.30 \log\left(\frac{5810}{T}\right) = 2.96$$

$$\log\left(\frac{5810}{T}\right) = 2.28$$

$$\frac{5810}{T} = 190.5$$

$$T = 30.5 \text{ days.}$$

Forbush gives 30 days as the incubation period of the Black Vulture.

Extending the line of Graph 2 for another logarithmic cycle (from 100 cubic inches to 1000 cubic inches), I have calculated some additional incubation periods from their egg volumes.

Several of these figures, as well as others below the 100-cubic-inch limit, warrant a few comments.

In the case of the cassowaries and Emu, I found dimensions of *Casuarius sclateri* and calculated an incubation period of 46 days for them. I could not find dimensions of eggs of *Dromiceius novae-hollandiae*, and therefore do not know how they compare in size with eggs of *C. sclateri*. However, these birds are both large, and their eggs are probably of nearly the same size. Newton gives the incubation period of *D. novae-hollandiae* as 70 to 80 days (average 75 days), while Brasil gives 35 to 42 (average 38.5). Since Brasil's data come within a week of my calculation for *C. sclateri*, I would accept his observation on *D. novae-hollandiae* rather than Newton's.

At the Philadelphia Zoo, seven young Rheas were successfully reared in 1937. Their keeper told me the eggs hatched in 45 to 50 days; most authorities state that this period is 35 to 40 days. An average of 47.5 days is, however, much more in accordance with my graph.

The incubation period of the Ostrich is given as 55 days by Coues (50 to 60 days) and as 42 days in the 'Encyclopedia Britannica.' Coues's median value, 55 days, falls within three days of my extended logarithmic curve, so that I am inclined to accept his estimate. Bergtold states that the Ostrich

suspends incubation frequently, upon which the eggs take longer than normal to hatch; many conflicting reports of incubation periods are probably due to this habit among certain birds.

The Whooping Crane's incubation period is calculated as 34.5 days. Forbush states his belief that the period is "at least 33 days." My formula gives *Apteryx* an incubation period of 42 days; Evans gives exactly the same figure.

It is amusing to speculate on the incubation periods of extinct birds. By my formula *Aepyornis* would have taken 85 days to hatch, several Moas would have taken 77, 73, 71, and 67 days to hatch, and a fossil ostrich from China would have taken 65 days. Eighty-five days in *Aepyornis* approaches the upper limit of 100 days set by the mechanism of shell structure and gas exchange in large eggs (Needham).

COMMENT

With the aid of these various tables and graphs, it is possible to see a constant relationship among the eggs of all birds, from the hummingbird to the Ostrich. What, really, is this relationship? It is an extension to all birds of the known course of embryonic growth of individual birds. The embryo increases in size according to a known daily pattern which can roughly be called a geometric rate of increase. For all birds the early developmental stages require a certain fairly uniform period; that much is also known for the progressive stages in the gestation of mammalian embryos. For the first six days the embryos of birds cannot be distinguished from mammalian or reptilian embryos (Beebe). But the later stages of avian embryological growth progress at higher and higher absolute speeds. This is why a sparrow's egg, though only 0.07 cubic inches larger than a warbler's egg, takes two days longer to hatch, while a Trumpeter Swan's egg, fully 7 cubic inches larger than a Whistling Swan's egg, takes only a little over two days longer to hatch.

The above consideration brings out the well-known correlation between the size of the egg and the state of the young when hatched. Altricial young have relatively shorter incubation periods than precociously cursorial or natatory young; birds whose young can run or swim at hatching lay relatively larger eggs, but the size factor adds time to the incubation period.

The Brush-turkey, *Lipoa ocellata*, has an incubation period of 38 days, to average the conflicting reports of Le Souëf and Campbell, while for an egg of its size (9.06 cubic inches) the theoretical incubation period is only 32.5 days, i.e., the deviation is 5.5 days from the average, or a half day more than the expected maximum deviation. This retardation can perhaps be explained on two bases: (a) the relative isolation and lack of predation in its natural habitat; (b) the lowered incubation temperature (about 90° F.).

This study might be pushed further to the correlation of birds' geographical distribution, egg sizes, and incubation periods. Bergtold's theory of "ascent," correlating taxonomic superiority and the resultant increase in temperature with an increase in the speed of incubation is only a vague empiricism which finds few exact applications to individual species of birds. Naturally the entire physiology of any bird—or of any egg-laying organism—must extend itself to the period of the embryonic life of that creature. Thus temperature becomes more or less of a constant in any reckoning of this sort, and one expects to find a certain metabolic increase for each additional degree of heat. It is in cases where the incubation period departs from the expected interval which a certain temperature would predicate that one must search for a factor that can modify developmental sequences apart from thermal dictates. This is the point where ecology operates, within the limits shown in Table 2.

The Megapodes, which presented such an obstacle to Bergtold's theory, fall smoothly into line with my graphs, tables, and reasoning, showing again that egg size and ecology determine incubation periods.

CONCLUSIONS

1. The volume of any egg may be fairly approximated from its primary measurements by the formula:

$$V = 0.85\left(\frac{\pi}{6}ab^2\right),$$

a being the long axis and b the greatest transverse diameter of the egg.

2. The incubation period increases in parallel with the fourth power of the increase in egg volume.

3. A study of relative incubation periods shows that, for an egg of any given size, there is an average incubation period as well as a probable limit to the positive and negative deviations from that average.

4. Given the size of an egg, it is possible to state the limits within which its incubation period is likely to fall; the period is given roughly by the formula:

$$V = .0063\left(\frac{1000V}{T}\right)^{1.30},$$

and an ecological correction not exceeding five days in either direction, may be made, if necessary, by the use of a table which has been presented in this paper.

5. The embryos of predacious birds have relatively slower growth rates than the embryos of many other birds.

6. Birds which have been preyed upon or otherwise harassed may: (a) acquire shorter incubation periods; (b) lay larger clutches of eggs without

shortening the period; or (c) lay larger clutches *and* shorten the period at the same time. In the last case the birds have probably been particularly frequent objects of destruction—there must have been, and perhaps still is, some particularly vulnerable point in their ecological adjustments to bring about such a doubled effort for embryological compensation.

7. Our present knowledge of the incubation periods of small birds in terms of days—not hours—precludes an accurate application of this study to their comparative embryonic growth rates.

8. Incubation periods vary according to the sizes of eggs and the ecological niches of the birds which lay them.

TABLE 1

EGG VOLUMES AND INCUBATION PERIODS (LISTED IN ORDER OF THEIR VOLUMES)

Species	*Volume* (*cu. in.*) (*V*)	*Incubation Period* (*days*) (*T*)
1. Trumpeter Swan	17.13	40
2. Whistling Swan	9.90	37.5
3. *Lipoa ocellata*	9.06	38
4. Little Brown Crane	8.41	31.5
5. Common Loon	7.98	29
6. Canada Goose	7.81	29
7. White Pelican	7.52	29.5
8. American Eider	5.96	25.5
9. Glaucous Gull	5.94	28
10. Common Murre	5.87	29
11. Brünnich's Murre	5.87	28
12. Black Vulture	5.81	30
13. Gannet	5.39	40.5
14. Brown Pelican	5.23	28
15. Lesser Snow Goose	5.18	28.5
16. Fulmar	5.15	55
17. Herring Gull	4.70	26
18. Caspian Tern	4.16	20
19. Skua	3.86	29
20. Great Blue Heron	3.73	28
21. Red-tailed Hawk	3.71	30
22. Ruddy Duck	3.65	30
23. Osprey	3.64	28
24. Redhead	3.49	23
25. Snowy Owl	3.48	32
26. (Domestic Fowl	3.47	21)
27. American Merganser	3.46	28
28. Red-breasted Merganser	3.46	28
29. Goshawk	3.42	28
30. Swainson's Hawk	3.35	26.5
31. Black Duck	3.19	27
32. White Gyrfalcon	3.14	29

TABLE 1 (continued)

EGG VOLUMES AND INCUBATION PERIODS (LISTED IN ORDER OF THEIR VOLUMES)

Species	*Volume (cu. in.)* (*V*)	*Incubation Period (days)* (*T*)
33. Red-shouldered Hawk	3.11	26.5
34. Rough-legged Hawk	3.10	28
35. Ring-billed Gull	2.95	21
36. European Cormorant	2.94	28.5
37. Hooded Merganser	2.80	31
38. Duck Hawk	2.76	28
39. Mallard (Wild)	2.65	26.5
40. Harlequin Duck	2.63	24.5
41. White Ibis	2.59	21
42. Black Guillemot	2.56	21
43. Parasitic Jaeger	2.52	24
44. Oystercatcher	2.43	24.5
45. Long-tailed Jaeger	2.28	23
46. Laughing Gull	2.28	20
47. European Widgeon	2.26	24.5
48. Gadwall	2.24	28
49. Broad-winged Hawk	2.21	24
50. Wood Duck	2.20	29
51. Old-squaw	2.14	24.5
52. Pintail	2.05	22.5
53. Shoveller	2.05	22
54. Black-crowned Night Heron	2.01	25
55. Sooty Tern	1.95	26
56. Franklin's Gull	1.94	19
57. Cabot's Tern	1.86	21
58. Common Tern	1.75	21
59. Glossy Ibis	1.75	21
60. Northern Raven	1.48	20.5
61. Blue-winged Teal	1.40	22
62. Green-winged Teal	1.31	22
63. Barn Owl	1.29	22.5
64. Willow Ptarmigan	1.22	25
65. Canada Spruce Partridge	1.21	17
66. American Crow	1.15	16.5
67. Kestrel	1.13	27.5
68. Pigeon Hawk	1.10	21
69. Dovekie	1.09	24
70. Clapper Rail	1.00	14
71. Screech Owl	.99	23
72. Purple Gallinule	.93	24
73. Woodcock	.93	20.5
74. Green Heron	.89	17
75. Ruffed Grouse	.86	24
76. Sharp-shinned Hawk	.82	22.5
77. Fish Crow	.75	17

TABLE 1 (concluded)

EGG VOLUMES AND INCUBATION PERIODS (LISTED IN ORDER OF THEIR VOLUMES)

Species	*Volume (cu. in.) (V)*	*Incubation Period (days) (T)*
78. Killdeer	.73	27
79. Burrowing Owl	.73	21
80. Kingfisher	.72	16.5
81. Pied-billed Grebe	.69	23.5
82. Passenger Pigeon	.69	14
83. Wilson's Plover	.62	24.5
84. Sanderling	.62	23.5
85. Northern Pileated Woodpecker	.57	18
86. Black Tern	.55	17
87. Least Tern	.54	15
88. Least Bittern	.51	15
89. Spotted Sandpiper	.49	15.5
90. Leach's Petrel	.48	35
91. Wilson's Petrel	.48	35
92. Bob-white	.47	23.5
93. Red Phalarope	.42	15
94. Nighthawk	.39	16
95. Yellow-billed Cuckoo	.37	14
96. Black-billed Cuckoo	.37	14
97. Eastern Robin	.36	12.5
98. Saw-whet Owl	.35	21
99. Mourning Dove	.34	13
100. Kingbird	.23	14
101. Snow Bunting	.14	14
102. Song Sparrow	.14	12
103. Yellow Warbler	.08	10
104. Ruby-throated Hummingbird	.03	14

TABLE 2

GROUPING OF SPECIES ACCORDING TO TEXT-FIGURE 2 (WITH AVERAGE CLUTCH OF EACH)

Incubation Slow	*Incubation Average*	*Incubation Fast*
GAVIIFORMES		Common Loon 2
COLYMBIFORMES Pied-billed Grebe 6		
PROCELLARIIFORMES Leach's Petrel 1 Wilson's Petrel 1 Fulmar 1		
PELECANIFORMES Gannet 1 European Cormorant 5	Brown Pelican 2.5	White Pelican 3

TABLE 2 (continued)

GROUPING OF SPECIES ACCORDING TO TEXT-FIGURE 2 (WITH AVERAGE CLUTCH OF EACH)

Incubation Slow	*Incubation Average*	*Incubation Fast*
CICONIIFORMES		
Black-crowned Night Heron 3.5	Great Blue Heron .... 3.5 Least Bittern 4.5	Green Heron ..... 4.5 Glossy Ibis ..... 3 White Ibis 4
ANSERIFORMES		
Trumpeter Swan .... 6 Mallard ..... 9.5 Green-winged Teal .. 9.5 Blue-winged Teal ... 10.5 Gadwall ..... 9.5 Black Duck ..... 9 Wood Duck ..... 10.5 Ruddy Duck ..... 10 Hooded Merganser .. 8.5 American Merganser. 11.5 Red-breasted do. 9	Whistling Swan ..... 5.5 Pintail ..... 8.5 Shoveller ..... 10 Old-squaw ..... 8 European Widgeon ... 7.5 Harlequin Duck ..... 7.5 Lesser Snow Goose ... 6.5	Canada Goose ..... 7 Redhead ..... 12.5 American Eider 6.5
FALCONIFORMES		
Goshawk ..... 3.5 Red-tailed Hawk .... 2 Rough-legged Hawk 3.5 White Gyrfalcon .... 4 Duck Hawk ..... 4 Kestrel 4.5	Black Vulture ..... 2 Sharp-shinned Hawk .. 4.5 Red-shouldered Hawk. 3 Broad-winged Hawk .. 3 Swainson's Hawk .... 3 Osprey ..... 3 Pigeon Hawk 5	
GALLIFORMES		
Ruffed Grouse ..... 10.5 Willow Ptarmigan ... 10.5 Bob-white 13.5		Canada Spruce Grouse 12 (Domestic Fowl) ..... (?)
GRUIFORMES		
Purple Gallinule 8	Little Brown Crane ... 2	Clapper Rail 10.5
CHARADRIIFORMES		
Wilson's Plover .... 3 Killdeer ..... 4 Sanderling ..... 4 Skua ..... 2.5 Sooty Tern ..... 2 Dovekie 1	Oystercatcher ..... 2.5 Woodcock ..... 3.5 Spotted Sandpiper .... 4 Red Phalarope ..... 4.5 Glaucous Gull ..... 2.5 Common Tern ..... 2.5 Cabot's Tern ..... 1.5 Black Tern ..... 2.5 Common Murre ..... 1 Parasitic Jaeger ..... 2 Long-tailed Jaeger 2	Herring Gull ..... 3 Ring-billed Gull ..... 3 Laughing Gull ..... 3 Franklin's Gull ..... 3 Least Tern ..... 2.5 Caspian Tern ..... 2 Brünnich's Murre .... 1 Black Guillemot 2
COLUMBIFORMES	Mourning Dove 2	Passenger Pigeon 1
CUCULIFORMES	Yellow-billed Cuckoo .. 4 Black-billed Cuckoo ... 4	

TABLE 2 (concluded)

GROUPING OF SPECIES ACCORDING TO TEXT-FIGURE 2 (WITH AVERAGE CLUTCH OF EACH)

Incubation Slow	*Incubation Average*	*Incubation Fast*
STRIGIFORMES		
Snowy Owl..... 7	Barn Owl..... 6.5	
Screech Owl..... 4		
Burrowing Owl..... 7		
Saw-whet Owl..... 5		
CAPRIMULGIFORMES		
	Nighthawk..... 2	
MICROPODIFORMES		
Ruby-throated Hummingbird..... 2		
CORACIIFORMES		
	Kingfisher..... 6.5	
PICIFORMES		
	Northern Pileated Woodpecker..... 4.5	
PASSERIFORMES		
	Northern Raven..... 6	Crow..... 4
	Fish Crow..... 4	Robin..... 4
	Kingbird..... 3	
	Snow Bunting..... 6	
	Song Sparrow..... 5	
	Yellow Warbler..... 4	
In this column: 38 species; average clutch..... 5.94	In this column: 43 species; average clutch..... 4.13	In this column: 21 species; average clutch..... 4.41

The predators in the left-hand column, including hawks, owls, and skua, average 4.27 eggs per clutch; the non-predators in the left-hand column, including all the others, average 6.65 eggs per clutch.

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Department of Zoölogy, Swarthmore College
Swarthmore, Pennsylvania

HOMING EXPERIMENTS WITH LEACH'S PETRELS

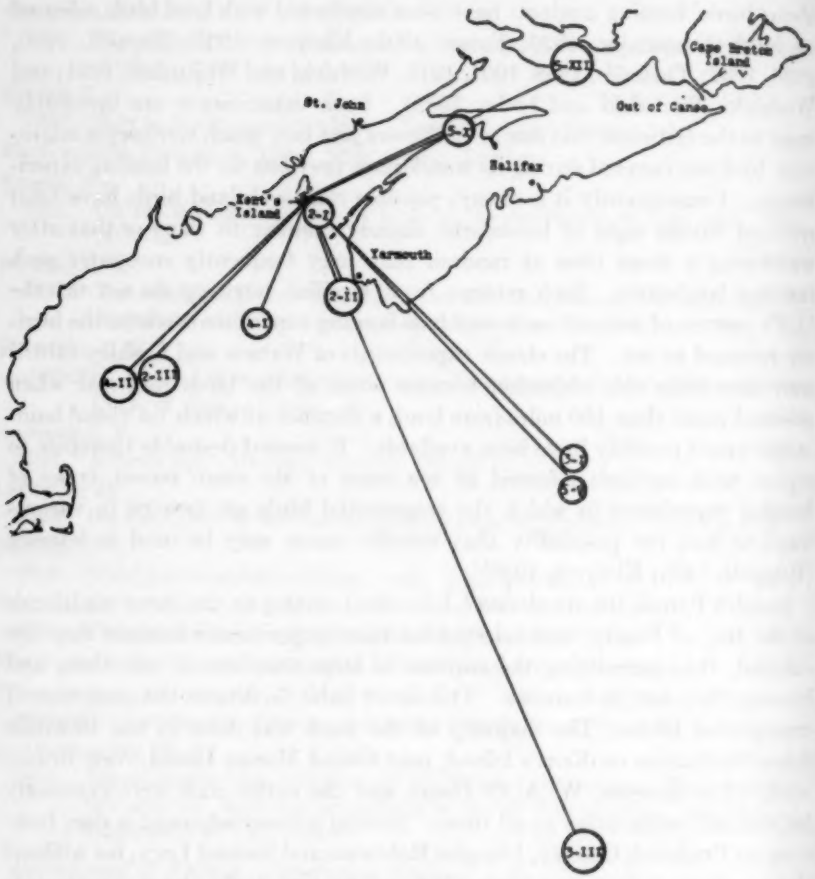
BY DONALD R. GRIFFIN

MOST of the homing experiments upon which are based our theories about birds' homing instincts have been conducted with land birds released on land (Casamajor, 1926; Exner, 1895; Kluijver, 1935; Rüppell, 1935, 1936, 1937; Thauziés, 1898, 1904, 1913; Wodzicki and Wojtusiak, 1934; and Wodzicki, Puchalski and Liche, 1938). Such experiments are inevitably open to the criticism that one never knows just how much territory a migratory bird has covered during its wanderings previous to the homing experiments. Consequently it is always possible that such land birds have been released within sight of landmarks already familiar to them or that after wandering a short time at random they may frequently encounter such familiar landmarks. Such returns from familiar territory do not tax the bird's powers of orientation as much as homing experiments where the birds are released at sea. The classic experiments of Watson and Lashley (1915) were free from this objection because some of the birds returned when released more than 150 miles from land, a distance at which no visual landmarks could possibly have been available. It seemed desirable therefore to repeat with seabirds released at sea some of the more recent types of homing experiment in which the transported birds are treated in various ways to test the possibility that specific senses may be used in homing (Rüppell, 1935; Kluijver, 1935).

Leach's Petrels (*Oceanodroma l. leucorhoa*) nesting on the outer sea islands of the Bay of Fundy were selected for these experiments because they are colonial, thus permitting the capture of large numbers at one time, and because they nest in burrows. This latter habit facilitates the recapture of transported birds. The majority of the work was done at the Bowdoin Scientific Station on Kent's Island, near Grand Manan Island, New Brunswick. The director, W. A. O. Gross, and the entire staff were extremely helpful and cooperative at all times. Special acknowledgment is due, however, to Frederick Greeley, Douglas Robinson and Samuel Lacy, for without their assistance in many unexciting and routine tasks these experiments could not have been conducted. I am also indebted to the Canadian National Steamships, Ltd., the Eastern Steamship Lines, and to Captain Henry Russell of Grand Harbor, New Brunswick, for carrying birds to sea in their ships. Professor K. S. Lashley has provided constant guidance and encouragement. The expenses of the summer's work were met by a grant from the Hodgson Fund.

Leach's Petrel is a highly specialized seabird which normally lays one egg a year in a burrow which it digs in the soil of some small island off the North

Atlantic coast. These habits, in addition to the bird's relative helplessness on land, render it very subject to destruction by predators. Apparently it nested even on the mainland until the advent of man, but domestic cats and dogs restricted it to sparsely inhabited islands. Even the Herring Gull will



TEXT-FIG. 1.—Homing experiments with Leach's Petrel.

often attack petrels near land during the daytime, and it is perhaps for this reason that the birds come to their nests after dark only. Petrels are never normally seen in daylight within about three miles of land, except, of course, for those that spend the day incubating their eggs below ground.

Fog is very prevalent in the Bay of Fundy and the petrels must normally find their way to land under conditions of darkness and fog where vision can

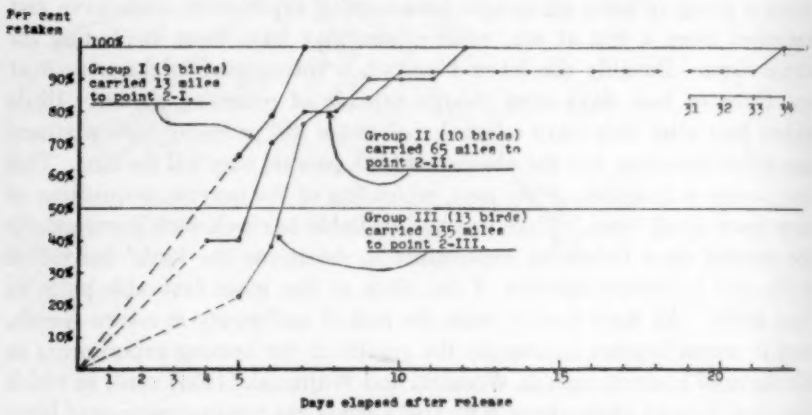
hardly play a part. Each bird spends three or four days at sea, and then returns to relieve its mate who has been incubating for that period. These visits to the nest are apparently made irrespective of the weather. All observers agree that the petrels are if anything more active on foggy nights, and my daily checks of many burrows disclosed no significant correlation between the weather and the number of burrows at which a shift of birds occurred.

Petrels have some disadvantages as experimental animals. I could not feed them successfully in captivity, although they would take small shrimps if these were forced down their throats. They have a tendency to desert their nests if too much disturbed, especially in the latter half of the incubation period, and their natural three- or four-day incubation cycle makes their exact homing time variable and hard to determine. For example, when a group of birds are caught for a homing experiment, some have just returned from a trip at sea, while others may have been incubating for three days. Possibly the latter birds when transported might remain at sea three or four days even though capable of returning sooner. Birds taken just after they have relieved their mate will probably have a strong incentive to return, but the absence of both parents may kill the egg. This may cause a desertion of the nest, rebuilding of the burrow, acquisition of new mate or all three. Time was not available to check each burrow daily for several days before an experiment to determine the birds' individual cycle and to enable selection of the birds at the most favorable point in that cycle. All these factors make for lack of uniformity in return speeds, and it seems clearest to compile the results of the homing experiments in the form of a curve, such as Wodzicki and Wojtusiak (1934) used, in which the time elasped after release is plotted against the total percentage of birds which had returned. These percentages are of course *cumulative*—the curve never goes down—and the end point is a horizontal line. If a fairly large number of birds is used in each experiment, comparison of the curves should disclose any significant difference present in the birds' homing behavior.

Experiment 1.—On June 25, 1938, seven petrels were taken to a point about twenty-five miles northwest of Kent's Island and released a mile or so from the mainland in a thick fog (visibility less than one hundred yards). Two were evidently somewhat confused, for they flew to a height of about a hundred feet and circled until lost to view. The rest flew off in various directions, none more than five feet off the water while still in sight (petrels never normally fly far above the water's surface). The fog did not lift until about twenty-four hours later. One bird returned during the first night, and two others the second night after release. All but one of the remaining birds were taken from burrows where no eggs were present, and

later experience showed clearly that petrels would practically always desert their burrows if they were caught and banded before the eggs were laid. This experiment suggested that fog may delay the birds when released twenty-five miles from their home island, but that at least one was able to return under those conditions before the fog lifted.

Experiment 2.—Thirty-two incubating birds were caught between 9 p. m. and 1 a. m. on the night of June 29 to 30 and carried by Diesel cargo vessel, bus and steamer to points 2-I, 2-II and 2-III on the map (Text-fig. 1). All of these birds were released in good condition, the weather conditions were favorable, and the birds left the ship in a great variety of directions on all three occasions. The results from these three groups of petrels are shown in Text-figure 2, a return curve of the type described above.



TEXT-FIG. 2.—Results of Experiment 2, including incubating birds only.

Subsequent experience showed that the first week of July is the most favorable time for homing experiments with Leach's Petrels in this region. Most burrows have eggs, and in the early stages of incubation the eggs are more resistant to temporary absence of the parents. This means that the transported birds are less likely on returning to find the eggs dead and then leave the burrow before they can be captured—a difficulty which was encountered later in the summer. I was unable to return to the island until four days after the birds of Experiment 2 were released, so that the earlier parts of the curves are uncertain. The results of Experiment 4 suggest, however, that the broken lines resulting from extrapolation are essentially correct.

Experiment 2 shows that practically 100% of the birds can find their way home from as far as 135 miles when released at sea where the nearest land

would be visible only at a height of about 730 feet.[1] The surprising point is that most of the birds released only thirteen miles from their nests did not return for five to seven days. This delay must have been due to factors other than difficulties of orientation; probably the petrels' three- to four-day incubation cycle delayed some of the birds' return. The most significant figure for the time of return is perhaps the *difference* between experimental and control curves. If judged by this standard 80% of the birds in groups II and III covered about sixty to seventy miles per day.

The fact that these speeds were not dependent on the distance transported indicates that random wandering was not the method by which the birds found their way home, for in that case the speed should decrease with greater distance since the birds must cover a greater *area* in their aimless flight. The speeds and distances are so small, in this case, however, that random wandering of group III might not show in the results. Largely to check this point birds were carried to greater distances in the next experiment.

Experiment 3.—Seventy-nine incubating birds were caught on July 10 and carried to East Ferry (near Tiverton), Nova Scotia, in the Bowdoin Scientific Station's cruiser. From there they were carried to Halifax by automobile and given to Mr. R. F. Leslie, chief officer of the S. S. *Colbourne* sailing from Halifax for the West Indies. These birds were released on July 12 and 13 as follows:

Group I (twenty birds), cage rotated on a phonograph turntable at about 25 r. p. m. for ten minutes at a time, about six times during the trip to Halifax. It was thought that this treatment should prevent any memory by the bird of the direction in which it was carried based on sensations from the inner ear. Group I was released at point 3-I on the map (Text-fig. 1), 170 statute miles from the nearest land and 280 miles from Kent's Island. (This bird would have to fly to a height of 11,000 feet before it could see land.) Visibility at time of release about one mile—weather moderate.

Group II (twenty birds) untreated, released at same time as group I.

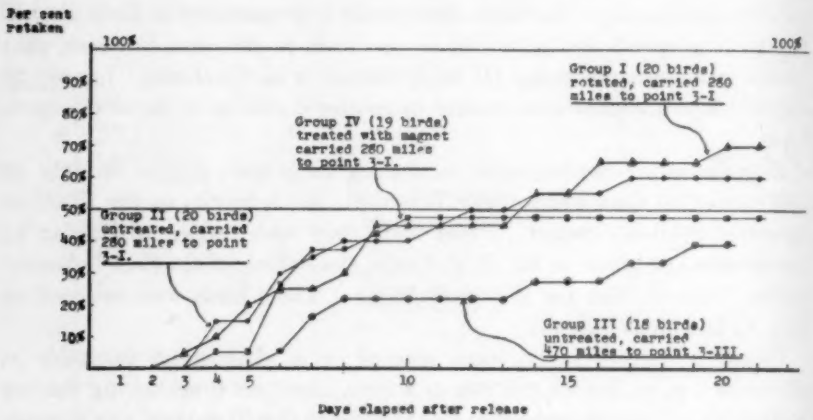
Group III (twenty birds) untreated, released at noon, July 13, at point 3-III on map, about 360 miles from nearest land and 470 miles from Kent's Island. This point is approximately at the center of the Gulf Stream. The weather was squally at the time of the release with a thirty m. p. h. wind and occasional heavy rain. Two birds were found dead in the cage when the rest were released. They had been in captivity for nearly three days without food, although water was provided to all the transported birds by placing a small sponge saturated with fresh water in each compartment.

[1] The formula for the distance, d, at which an object h feet above sea level is visible to an observer h' feet above sea level is approximately $d = 1.317\ (\sqrt{h} + \sqrt{h'})$ miles.

Here the height of the nearest land is not more than 500 feet and $d = 65$ miles; thus: $65 = 1.317\ (\sqrt{500} + \sqrt{h'})$, or $h' = 730$ feet.

According to Mr. Leslie's report "50% were fairly active although appearing much weaker than birds in groups I, II, and IV. The sudden rise in air temperature entering the Gulf Stream has a depressing effect on humans and this no doubt would be felt by the birds."

Group IV (nineteen birds). These were released at the same time as group I and were handled in the same manner except that before leaving Kent's Island each bird was held for about thirty seconds in the field of a powerful electromagnet (field strength throughout bird's head at least 500 gauss). This treatment, it was thought, might disclose whether any of the magnetic theories of homing could be applied to the petrel. It seems likely



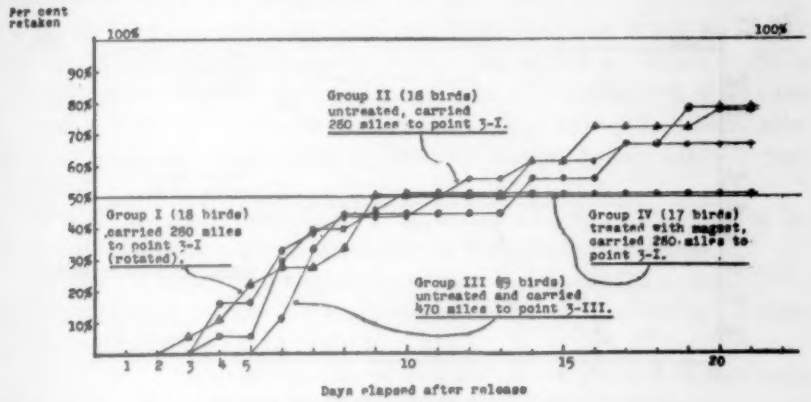
TEXT-FIG. 3.—Results of Experiment 3. Curve A, returns plotted as percentages of total birds released alive.

that any magnetic receptor sufficiently delicate to satisfy the postulates of Viguier (1882), Thauziés (1898), Casamajor (1926) and Stresemann (1935) would be seriously injured by such a treatment and that if magnetic senses were involved in the homing of the petrel this group treated with a magnet might show a delayed homing. This experiment held only a bare possibility of confirming the magnetic theories; negative results would not necessarily disprove them.

Neither the rotation nor the treatment with a magnet had any noticeable effect on the return curves of groups I and IV as compared to the untreated birds of group II. There is no reason to infer from the group III curve (Text-fig. 3) (even if uncorrected for the poor condition in which the birds were released) that the speed of return depends on the distance transported as it should if the birds were merely wandering at random until they found some familiar landmark. This is probably the case even if the return time

is taken as the difference between the actual time and that taken by the birds of Experiments 2 and 4 which were released at or near the home island.

Undoubtedly the longer time without food left the birds of Experiment 3 in poorer condition at the beginning of their return trip than those of Experiment 2. It would have been desirable to remedy this situation by faster transportation, but this was impossible. However, a truer picture of the results can be obtained by a simple quantitative treatment of the source of uncertainty, namely, the poor condition of the birds of group III. According to Mr. Leslie's report 50% of these birds were in poor condition while "90% of the birds of groups I, II and IV were active and flew away immediately in northwest direction (approximately toward their home).



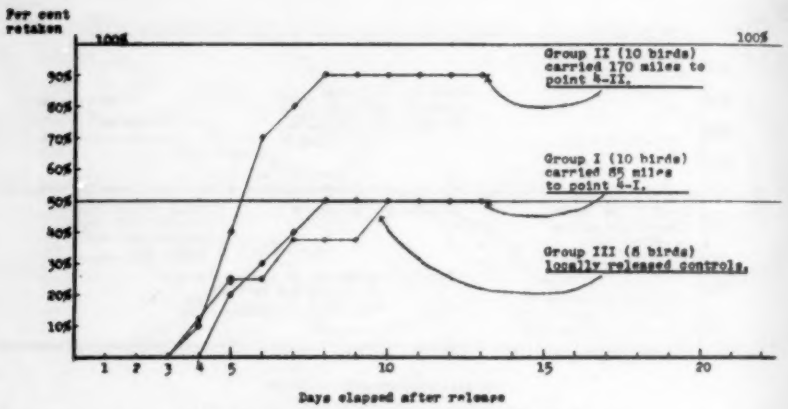
TEXT-FIG. 4.—Results of Experiment 3. Curve B, returns plotted as percentages of birds estimated to have been released in good condition.

Three or four were making short flights and appeared to have difficulty in rising from the sea."

I have therefore plotted the returns from Experiment 3 in a separate curve (Text-fig. 4, return curve 3b), assuming that only 90% of groups I, II and IV survived and that only 50% of group III were able to make the return journey. Subsequent experience gained in Experiment 5, in which birds were observed after two or three days in captivity suggested that this estimate was reasonable. Inspection of Text-figure 4 shows that if the above assumptions are valid there was little difference between the percentages returning from the various groups.

Experiment 4.—Thirty birds were caught from burrows containing eggs on the night of July 20 and carried by fishing boat, automobile and steamer to points 4-I and 4-II on the map. The former is 85 miles from Kent's Island and 65 miles from the nearest land; the latter is 172 miles from the

island and 65 miles from the nearest land. Group III was released on Kent's Island as controls. I remained on Kent's Island to check the burrows from the beginning, which had not been possible in Experiment 2. The two transported groups were kept in captivity for 48 and 53 hours due to an accidental delay. The control birds (group III) were held for three days so that I could observe for myself how that period in captivity affected the birds and judge its probable influence on the birds of Experiment 3, group III. Another reason for the long period in captivity for the controls was that their eggs would remain unincubated for more nearly as long as those of the transported birds, and no difference in the percentage retaken should result from that cause.



TEXT-FIG. 5.—Results of Experiment 4.

The actual results (Text-fig. 5) were paradoxical. The birds from group II (carried 170 miles) returned more rapidly and in greater numbers than the locally released controls. This must have been because of the poor condition of the latter, but this fact confirms the results of Experiment 2 in showing no dependence of speed of return on distance transported.

It is interesting to compare the curves for Experiment 3, group III, released 470 miles from Kent's Island and group III of Experiment 4; for both groups were kept without food for approximately the same time (three days). The difference in time of return and percentage returning is very slight, and suggests that the low percentage retaken from the release at 470 miles was due to factors other than the birds' powers of orientation.

Experiment 5.—Seventy-two birds were caught on August 3, 4 and 7, on Little Wood Island. All were taken from burrows containing eggs, although at this date many petrels have young and the eggs of others are nearly ready to hatch. These birds were treated as follows:

Group I (twenty birds) kept in captivity forty-eight hours and released locally in good condition.

Group V (seven birds) untreated, released at point 5-V on map after about three days in captivity. This long period in captivity was caused by the fact that the ship was nearly twenty-four hours behind schedule in reaching Halifax.

Group VII (seven birds) released at same time as group V but treated before transportation with electromagnet (field strength about 9700 gauss).[1]

Group VIII (ten birds) locally released controls for group VII, treated with magnet but released on Kent's Island forty-eight hours after capture, about three miles from their nests.

Group IX (five birds) released at same time as group V but rotated on phonograph almost continuously during trip as far as Windsor, Nova Scotia. Up to that point the cage was spinning all but about 5% of the time.

Group X (five birds) untreated, released about twenty-four hours after capture at point 5-X on map in the upper Bay of Fundy; birds in good condition.

Group XI (five birds) released at same time as group X but treated before transportation with electromagnet as described under group VII.

Group XII (five birds) untreated, released in fair condition about forty-eight hours after capture at John Bay (point 5-XII on map) on the southern shore of the Gulf of St. Lawrence.

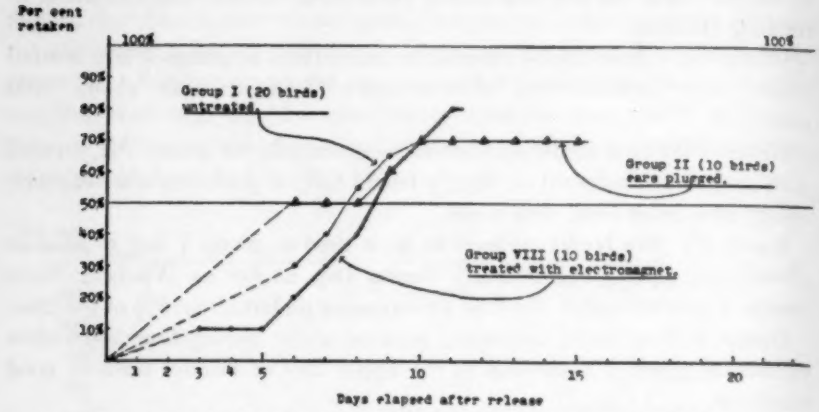
Group XIII (three birds) released at same time as group XII, but 'magnetized' as group VII had been with a magnetic field of 9700 gauss.

Group XIV (three birds) released at same time as group XII, but rotated just as group IX had been.

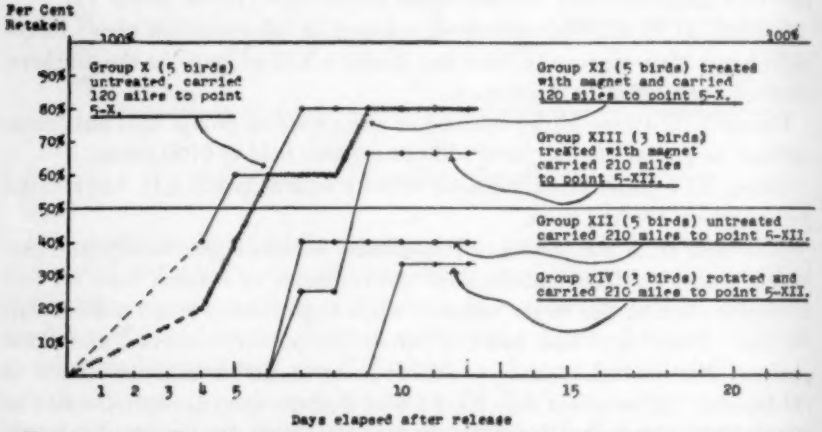
It is clear from the results of Experiment 5 (shown graphically in Text-figures 6 and 7) that conditions for the recording of returns were far less favorable than earlier in the summer when Experiments 2 and 3 were conducted. Many eggs had hatched before the parents returned and these parents often visited their nests almost every night but did not remain in the burrow. After about July 25, I found that the returns secured could be increased materially by inspecting all burrows at regular intervals throughout the night. This procedure had its dangers, however, as too much attention to the burrow with the inevitable disturbance occasioned by reaching into it may have caused desertions which would not otherwise have occurred. All of these factors reduced the percentages retaken in both Experiments 4 and 5. This fact is obvious on inspection of the percentages

[1] I am greatly indebted to the Harvard Engineering School for allowing me to use this electromagnet and to Mr. L. P. Winsor for measuring the flux density which was produced between its poles.

recorded for the locally released controls at different times during the summer (100% on July 1, 50% on July 23 and 70% to 80% on August 8). Therefore it is obvious that the returns from the experimental groups cannot be expected to be as high as those obtained in Experiments 2 and 3.



TEXT-FIG. 6.—Results of Experiment 5; locally released controls.



TEXT-FIG. 7.—Results of Experiment 5. Groups X, XI, XII, XIII, and XIV (birds carried north from Grand Manan Island into territory presumably unfamiliar to them).

The petrels released on August 10 south of Halifax (point 5-V) did not return as rapidly or in as high percentages as those of Experiment 3, that had been released at approximately the same point. The curves for these three groups showed no effect of the various treatments, and since they do not add anything to the results of Experiment 3 they are not reproduced.

The birds of groups X to XIV are of some interest because they were re-

leased in territory presumably unfamiliar to them. It is doubtful if Leach's Petrels nesting on Kent's Island or Little Wood Island had ever visited the upper reaches of the Bay of Fundy, and almost inconceivable that they had visited Northumberland Straits in the southern half of the Gulf of St. Lawrence. The returns from the upper Bay of Fundy showed a speed and percentage retaken comparable to Experiment 2; homing from that point presents no special theoretical problems since the birds would have only to follow the coast line in either direction until they came to familiar waters.

Groups XII, XIII, and XIV were carried to Northumberland Strait because of the large difference in distance between a straight course over Nova Scotia and the water route around Cape Breton Island. The shortest distance from point 5-XII to the home island is about 210 statute miles. Via the Gut of Canso the distance is about 500 miles and around Cape Breton it is about 710 miles. The average speed of return of these birds is shown in Table 1 in comparison with the homing speed of petrels in other homing experiments.

One is forced to conclude from this table either that the birds of groups XII and XIII (untreated and 'magnetized') averaged very much faster flights (while all the factors of birds' condition, and stage of the nesting season tended in the opposite direction) or that they flew over at least eighteen miles of land, a most extraordinary action for so strictly marine a bird as the petrel. This apparent straight-line flight over a new and strange environment points definitely toward a very strong ability for absolute orientation. Unfortunately, however, after the mortalities of the long trip, prolonged by the delay at Halifax in waiting for the steamer, there were only eight birds in these two groups in such condition that it seemed possible for them to survive. It is certainly dangerous to base any general conclusions on such small numbers of individuals.

The group that was carried to the Gulf of St. Lawrence and rotated during a part of the journey is especially interesting. Only three of these birds survived this trip, and only one was retaken at Little Wood Island. This bird required ten days for the trip. This case is not so clear-cut as the results from groups XII and XIII for in previous experiments a few of the first arrivals had attained the speed which this bird would have registered if it had flown around Nova Scotia. This uncertainty demonstrates very clearly the desirability of using large numbers of individuals in each group and of good experimental conditions. It is hoped that future homing experiments, benefiting from my experience, may satisfy these requirements.

It is interesting to note that Dircksen (1932) released in the Baltic terns nesting on the coast of the North Sea and that in at least one case the speed of return was so high that a direct overland flight (perhaps following the Kiel Canal) seems more probable than a detour around Denmark. Further-

TABLE 1

HOMING SPEEDS OF LEACH'S PETRELS

Experiment number	*No. of birds released*	*Distance carried*	*Mean homing speed (miles per day)*	*Remarks*
2-II	10	65 miles	10.5	
2-III	13	135 miles	18.5	
3-I (rotated)	20	280 miles	28.5	
3-II	20	280 miles	30.8	
3-III	18	470 miles	42.3	
3-IV ("magnetized")	19	280 miles	41.2	
4-I	10	85 miles	13.0	
4-II	10	170 miles	29.3	
5-V	7	272 miles	36.0	
5-VII ("magnetized")	7	272 miles	32.5	
5-IX (rotated)	5	272 miles	36.0	
5-X	5	120 miles	24.0	
5-XI ("magnetized")	5	120 miles	20.0	
5-XII	5	210 miles	30.0	Assuming birds flew back on an air line.
5-XIII ("magnetized")	3	210 miles	26.3	
5-XIV (rotated)	3	210 miles	21.0	
5-XII	5	231 miles	33.0	Assuming birds flew the course requiring the shortest overland flight.
5-XIII ("magnetized")	3	231 miles	29.0	
5-XIV (rotated)	3	231 miles	23.1	
5-XII	5	500 miles	71.4	Assuming birds flew through Gut of Canso.
5-XIII ("magnetized")	3	500 miles	62.5	
5-XIV (rotated)	3	500 miles	50.0	
5-XII	5	710 miles	101.4	Assuming birds flew around Cape Breton Island.
5-XIII ("magnetized")	3	710 miles	88.7	
5-XIV (rotated)	3	710 miles	71.0	

more there is the remarkable fact that one of two Manx Shearwaters sent by Lack and Lockley (1938) from the coast of Wales to Venice, Italy, outside the known range of the species, returned to its nest in fourteen days. The overland distance in this case is 900 miles, requiring the strictly marine shearwater to cross the Alps, while the distance by water is 3700 miles. These results certainly indicate strongly a power of absolute orientation capable of guiding these three genera of birds over totally unfamiliar territory.

SUMMARY AND CONCLUSIONS

(1) Leach's Petrels lend themselves well to homing experiments, although they may not be the best bird for the purpose and are certainly not ideal. The first week in July is the best time to transport them from the outer sea islands in the Bay of Fundy, for they are least likely to desert their nests at that time. Since petrels cannot very conveniently be fed in

captivity they should be carried to the point of release within twenty-four or at most forty-eight hours.

(2) A large percentage of the birds returned from distances up to 360 miles from the nearest land and 470 miles from their nests.

(3) Several birds seem to have flown over at least eighteen miles of high wooded land rather than follow the coast line around Nova Scotia.

(4) Vision can probably be eliminated from consideration as a means by which the birds find their way home by the distance from land to which they were carried and because they were transported in covered cages.

(5) Memory of the direction transported as perceived by means of the inner-ear labyrinth seems not to be necessary, for homing was equally rapid and consistent after birds were rotated during part of the transportation. Further experiments with better apparatus enabling rotation of the birds throughout the trip would be necessary to establish this point with absolute certainty.

(6) Random wandering as a means of homing is made quite unlikely by the combination of results indicating that the speed of return is independent of the distance, and that the birds apparently return in a direct line, over land if necessary. Random wandering in the case of the birds released in Northumberland Strait would presumably have been confined to the water.

(7) The homing ability of the petrels was not affected by subjecting them for several seconds to a magnetic field many hundred times as intense as the earth's field.

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Biological Laboratories
Harvard University
Cambridge, Massachusetts

NICOLAS DENYS' BIRDS

BY FRANCIS H. ALLEN

A READING of Mrs. Elsa G. Allen's paper on Nicolas Denys in the July 'Auk' suggests that a revision of the identifications given in the English translation of his 'Description Géographique et Historique des Costes de l'Amérique Septentrionale, avec l'Histoire Naturelle du Païs' (1672) may be needed. The translator, Professor Walter F. Ganong, of Smith College, was well equipped for his work by years of study of Denys' life and an intimate acquaintance with the country, and as a botanist he could identify Denys' plants with authority. In ornithology, however, he was not so well equipped, and although he approached the birds with a scientific conscience, his lack of a firsthand knowledge of the avifauna of Acadia and of birds in general led him into some evident errors. Denys used the old French fishermen's names, some of which are still in use in France or in Canada, while others have fallen into disuse and in some cases cannot be positively identified. After delving into dictionaries of both modern French and old French and consulting such ornithological works as those of Brisson and Buffon, besides some of the old French explorers, I am now offering the results of a research that does not pretend to be exhaustive.

Taking up the birds as they appear in Mrs. Allen's article, we have first the 'happefoye,'[1] which Ganong identifies—correctly, I think—as the Fulmar. The French name signifies 'liver-snatcher.' Dr. Ganong says in a footnote that it is "not to be confounded with the related Hagdon, or Greater Shearwater," but his confidence in that conclusion is not explained until we find that Dièreville in his 'Relation du Voyage du Port Royal' (Rouen, 1708) speaks of the 'Hape-foye' as having the back gray and the belly white. To be sure, Dièreville gives 'fauquet' as the name by which the bird is called by the Normans, and it appears that *fouquet* (with an *o*) is variously defined as a petrel of Mauritius and a tern; but no tern has the hooked beak (*bec crochu*) mentioned by Dièreville, and the 'gray back' seems to make it certain that these liver-snatchers were Fulmars.

Next we have the 'Croiseurs,' which Ganong identifies as Wilson's Petrels in a footnote, though in his text he calls them simply Petrels. In this identification I think he must surely be mistaken. The description seems to fit the Greater Shearwater perfectly. Denys says of the 'Croiseurs,' "Their flight is different from that of other birds in this, that they fly, so to speak, crosswise, having one wing up towards the sky and the other towards the sea, so that, in order to turn, they bring the upper wing undermost."

[1] I follow the original as to capitalization.

Compare that with this from Dr. Charles W. Townsend's description in Bent's 'Life Histories of North American Petrels': "Now they turn on their side with one wing just grazing the water, the other high in the air." And what can be more descriptive of the shearwaters' ways than Denys' "They are called Croiseurs because they are ever crossing on the sea from one side to the other"? On this habit of the shearwaters see my note in the 'Auk' for July, 1936, pp. 320, 321. In modern French *croiseur* signifies 'cruiser,' and Littré's great dictionary gives, as one definition of the word, '*hirondelle de mer*,' that is, 'tern,' but *croiseur* seems not to be commonly used for any species of tern, and no tern could have been "found always from the time one is at sea a hundred leagues from land as far as New France." To be sure, *hirondelle de mer* might be an appropriate name for Wilson's Petrel, but, as a matter of fact, it seems to be confined to the terns, just as the name 'sea-swallow' is in English.

Denys' 'Poule de mer' is probably correctly identified as the Guillemot, or, as we call it in this country, the Murre, and of course his 'Pennegoin' is the Great Auk. He begins his account of the other waterbirds, those found near the shore, with the Canada Goose, which he calls the 'Outarde,' or Bustard, as the French Canadians do still. As Mrs. Allen did not quote these first paragraphs, and in order to complete the account, I am including them here in my own translation, which is not very different from Dr. Ganong's, though perhaps a little more literal.

"It [the *Outarde*] is of the size of a turkey. Its plumage is gray brown like that of a goose, white beneath the throat. The savages make robes of it. They lay only every two years; the year in which they do not lay they moult.

"The young *outardes* do not lay till they are four years old. Their clutch is fourteen, fifteen, and sixteen eggs. They make their nests on islands or in marshes, usually on the ground. Nevertheless, there are some that make them in trees, and when their young are hatched, they place themselves on the back of the father or the mother, who carries them to the water in one or two trips. Those that nest on the ground lead theirs also to the water as soon as they are hatched. At night the mother leads them back to land to brood them, and always on some island or marsh on account of the foxes, which make war on them.

"There is another species which is smaller [not 'much smaller,' as Ganong has it], but otherwise it is just the same. Its flesh is good and very excellent to eat roasted and boiled. They make very good soup. Their broth is white. The flesh is also good salted; its taste is much better than that of a goose [*oye*], and it is not so hard to digest. Those that have not yet laid have a better taste than the others. Their food is only grass.[1] They feed

[1] The original is *de l'herbe*, which in French can mean either grass or any herbaceous plant.

in marshes or meadows on the seashore. If they find themselves in places where the sand is muddy, where grows grass of the length of a fathom and more, very narrow and reaching nearly to the surface of the water [eelgrass, of course], that is the pasturage they like best. In those places one never fails to find them, besides which they like better to be on the water than on land for fear of surprise.

"Wherever they are, there are always one or two, if they are in large numbers, that mount guard and do not eat, walking from one side to the other looking all about: if they see or hear anything in the woods, at once they cry out and all the others raise the head and remain like that for a time. If the sentinel says not a word, they begin eating again, but if he hears or sees anything, he utters another cry and makes off, and so do all the rest at the same time."

This smaller species that was so fond of eelgrass was evidently not the Brant, because that bird is described in the next paragraph under the name 'Cravan,' which is known to be a synonym of the *bernache* of the modern French Canadian. Dr. Ganong thought that it could not have been Hutchins's Goose because "that species is not a resident of Acadia" and suggested that Denys might have referred to "smaller forms, perhaps young birds, of the Canada Goose." The description of it, however, as smaller and in every other respect just the same, together with the statement later that "the *Cravan* is scarcely smaller than the small *outarde*" really does seem to fit pretty well with *Branta canadensis hutchinsi*, or *Branta hutchinsi*, as described by Taverner in his revision of the group. Is it possible that in Denys' time this form may have been a regular visitor to some parts of Acadia on its way to and from its breeding grounds on Baffin Island?

Nothing further need be said of the *Cravan*, or Brant, but the 'macreuse' to which Denys compared it except for the taste, was not the Widgeon, as Ganong has it, but a Scoter. *Macreuse* is the name for Scoter, not only in France but in French Canada (see Taverner's 'Birds of Eastern Canada').

As to Denys' ducks, anyone is at liberty to do his own guessing. Perhaps he distinguished between *Anas rubripes rubripes* and *A. r. tristis!* Dr. Ganong's suggestion of the Labrador Duck for the species of which "the male is white, with black at the end of the wing" may be a good guess. It could hardly have been the Greater Snow Goose, because Denys knew that bird and mentioned it in an earlier passage not quoted by Mrs. Allen, where he spoke of 'oyes blanches et grises,' geese white and gray. When Denys said that this duck tasted of oil like the 'macreuse,' he was comparing it, as in the case of the Brant, to a Scoter, not a Widgeon.

For 'Sarcelle,' 'Plongeon,' and 'Poule d' eau,' Teal, Loon, and Coot are obviously the correct translations. 'Palonne' has escaped both the modern and the Old French dictionaries that I have consulted, but the masculine

form *palon* was an old French name for a particular kind of spatula, and *spatule* is modern French for both 'spatula' and the European Spoonbill. The fact that no Spoonbill inhabits Acadia, except the Shoveller Duck sometimes so called, together with the extremely long bill described, makes it seem as if Denys must have confused the duck with his recollections of the Spoonbill in France. The Night Heron may very likely have been the 'aigraite' with 'three little feathers straight up on its head,' even though the Night Heron's plumes are not commonly erected. At any rate, Ganong's guess appears to be a good one. For 'bec de scie' Sheldrake, or Merganser, is right, of course, and so is Long-tailed Duck, or Old-squaw, for *Cacaoüy*, 'Cockawee' being still used for that bird in Canada. Ganong's identification of Denys' 'Marionnettes' (two *n's* in the original French) is clearly correct, too, for he was informed that the Acadians still used that name for the Buffle-head, and he cites Baird, Brewer, and Ridgway as stating that it is used for it about New Orleans, presumably brought there by the exiled Acadians. As a matter of fact, Baird, Brewer, and Ridgway got the name from Audubon, who considered it a very appropriate name for the species. Razor-billed Auk seems to be correct for 'Gode' (Taverner gives 'Godd or Gudd'), and there can be no doubt about the Cormorant—except that Ganong in a footnote assumes that the species was the Common Cormorant.

The paragraph on the shorebirds badly needs revision. In the first place, the 'Alloüettes' (modern French *Alouettes*), though the name literally means larks, are, according to C. E. Dionne in 'Les Oiseaux du Canada,' *Maubèches*, that is sandpipers, not plovers. Ganong thought it likely, as stated in a footnote, that the two largest species mentioned were the Black-bellied and Golden Plovers, but the Golden Plover, the smaller of the two, has a shorter, not a longer, bill. It is useless to try to guess what they really were. *Alouette de Mer*, it should be said, however, was a term used by Brisson and some other French naturalists for certain small sandpipers, but also in the case of the *Alouette de Mer à Collier* for the Ringed Plover of Europe, as is shown by a figure in Buffon. It seems very probable, therefore, that the name was loosely applied to any small shorebird. By the way, it is probable that the reference to 'long feet' in connection with the 'Alloüettes' should have read 'long legs.' It seems to be not uncommon for the French to call the tarsi of birds *pieds* (feet), which, of course, they actually are. Thus the Stilt Sandpiper is called in Canada *la Maubèche à longs pieds*, and the Redshank of Europe was called by Buffon *le Chevalier aux pieds rouges*. Ganong translates 'Chevalliers' by 'Sandpipers,' but the *Chevaliers* (to use the modern spelling) are, in modern usage, the tattlers, such as our Yellow-legs. In the present case, however, it seems clear from the description that the name is applied to the Dowitchers. Denys says they are a kind of

'beccasse' with a very long bill and that they are of the same size and have legs as long as the 'beccassine,' and the plumage redder. *Bécasse* and *becassine* are French for 'woodcock' and 'snipe' respectively, not 'Snipe' and 'Small Snipe,' as Ganong translates them; but of course Denys uses *béccasse* loosely. The terns, Herring Gull, and herons of the next paragraph are undoubtedly correctly identified.

We now reach the land birds. The eagle with a 'white ruff' Ganong identifies in a footnote as the Bald Eagle, and very properly, though 'ruff' (*fraise*) seems an inappropriate word. He thinks it probable that the 'smaller species' referred to was the Gyrfalcon, but we are at liberty to suppose that it was a commoner bird. The 'Faucon' and the 'Autour' are probably correctly identified as Duck Hawk and Goshawk, but it is not so clear that the 'Tiercelet' was the Pigeon Hawk. That word was applied to the male Peregrine and the male European Sparrow Hawk, according to Larousse. The hawk that captured only fish is identified by Ganong in a footnote as the 'fish-hawk' (Osprey), naturally.

Just what the 'three kinds of Partridges' were that Denys recognized is not entirely clear. Obviously the red one must have been the Ruffed Grouse and the black the Spruce Grouse, or at least the male of that species. His description of the gray partridge, however, presents a little difficulty. Both the Canada Ruffed Grouse and the Nova Scotia subspecies have red and gray phases, so that we cannot assume that his red and gray birds were necessarily of different races. He might have found the two colors together in any part of his domain. But he found a difference in taste between the red and the gray, the latter having a taste of venison, and I believe there is no detectable difference in flavor between the two color phases of any subspecies of *Bonasa umbellus*. Of the black partridge he says that its venison flavor is so strong as to make it 'less good than the others,' that it tastes of juniper berries and fir (or spruce, *sapin*). It is well known that the flavor of Spruce Grouse varies with the season, and it is at least possible that Denys, who certainly was not the most accurate of observers, may have considered the female Spruce Grouse with its taste of venison, eaten by chance when the flavor was not at its strongest, to be of a different species from the male. At all events, the female Spruce Grouse is a gray bird rather than a black one, and it may be safest to leave Denys' 'gray partridge' unidentified.

Before leaving this subject of the three grouse I find I must give a more literal translation of the section that describes the tails of the birds, so that it shall be clear that the colors there given are those of the tails alone and that all three kinds are included. Punctuated as in the French it reads: "All these kinds of partridge have the tail long, they open their tail like a turkey fanwise, they are very beautiful, the red *has it* mingled of red brown

and gray, the gray of two grays, one clear the other brown, the black of gray and black, they have been taken to France and have been given to sundry persons who have made fans of them which have been thought beautiful." The italics are mine.

All things considered, it seems unsafe to assume that two subspecies of *Bonasa umbellus* were at that time present in any one part of Denys' Acadia; and as to the Gaspé Peninsula in particular, so far as the record shows, Denys never lived there for any length of time, though he did make his home for some years at Nepisiguit (now Bathurst) just across the Bay of Chaleurs in what is now New Brunswick.

The 'becasses de bois' were Woodcock undoubtedly. The 'corbeaux' were probably both Crows and Ravens, since both species inhabit the region. The name *Corbeau* is now applied only to the Raven, *Corneille* being used for the Crow, but formerly it was used for any bird of the genus *Corvus*.

Denys' 'Orfrayes' present a peculiar problem in vernacular nomenclature, though the description points, unmistakably I think, to the Nighthawk, as Ganong concluded. *Orfraye*, or *Orfraie*, is really the word for the Sea Eagle of Europe (*Haliætus*), not the bird known in English as the Osprey, but, as Larousse says, the name is often confounded with that of the *Effraie*, a species of owl, apparently the Short-eared Owl. I cannot find that it was ever used for the Goatsucker, and I judge that Denys thought these birds were owls. And if he did, he came nearer to the truth than the Englishmen who called them Night Hawks!

Ganong's identification of the 'Chat-huant' as the Barred Owl may very well be correct, as that name is applied in France to the Tawny Owl, a bird of the same genus. As Ganong says in a footnote, however, the 'white ruff' suggests the Great Horned Owl, so that we may leave the matter in some doubt. But it may be remarked incidentally that the well-known fondness of the larger bird for including skunks in its menu would not tend to make it 'better and more delicate eating than the chicken'!

The 'Merle' is, of course, our Robin. The woodpeckers that were called *Gays* seem to me unlikely to have been Red-headed Woodpeckers, a species that is now of only casual occurrence in the region. I suggest that, with the help of an active imagination, the Yellow-bellied Sapsucker might have seemed to have the head all red and the neck of a real flame-color. The hummingbird is unmistakable. The swallow ('Hyrondelle') was, I feel quite sure, the Barn Swallow, now considered by many only subspecifically different from the European bird and therefore very properly thought by Denys to be 'the same as in France.' Ganong's footnote suggesting the Cliff Swallow is probably mistaken.

Mrs. Allen quoted in her 'Auk' paper Dr. Ganong's translation of everything Denys had to say about Acadian birds in the pages devoted to the

natural history of the region, with the exception of the passage that I have myself already quoted about the geese. There are, however, scattered through the book a number of mentions of birds that it may be well to speak of for the sake of completeness. On pages 199 and 216 of the translation the huge flocks of Passenger Pigeons are described. Their numbers are spoken of as 'incredible' and 'an infinity.' Denys once stayed eight days near the mouth of the Miramichi River, and every morning and evening saw flocks passing of which the smallest were of five or six hundred. "Some alighted on the meadows and others opposite upon a point of sand on the other side of the river. They did not remain on the ground more than a quarter of an hour at most, when there came other flocks of them to rest in the same place; the first ones then arose and passed along." The Pigeons fed on strawberries and raspberries and abounded on Bonaventure Island, where grew large quantities of those berries (page 225).

On pages 384–385 Denys tells how foxes caught geese and ducks by decoying them out of the water, and on pages 435-436 he tells how the Indians drifted down upon the flocks of geese, brant, and ducks in their canoes and upon reaching them lighted birchbark torches and knocked down the bewildered birds with sticks.

Other birds that are mentioned casually are Eiders (*Moyaques*), Puffins (*Perroquets de mer*), Black Guillemots (*Pigeons de mer*), cranes (*Gruës*), which, as Ganong says, were doubtless Great Blue Herons, plover (*Pluviers*), and curlews (*Corbegeos*, or, in modern French, *Corbigeaux*).

On page 129 a list of birds found on the Tusket Islands of Nova Scotia includes Turnstones. The original has the word 'tournevires,' and Ganong in a footnote says, "*Tournepierres* in modern French, unmistakably the well-known and common turnstone of the region," but gives no authority for Denys' form of the word as applied to the Turnstone. Denys himself in another place employs the word in the singular for a rope used to move boats back and forth between moorings and wharf. It is possible his use of the word for a bird was a bit of carelessness, but the verb *tournevirer* in Old French meant 'turn around,' and the noun *tournevire* would be so appropriate for a phalarope that it seems not at all unlikely that the Northern Phalarope, a species that is extremely abundant in migration in some parts of Denys' Acadia, may have been the 'tournevire' (whirligig?) he had in mind. Here in this same sentence, and elsewhere too, Ganong translates 'beccasses' and 'beccassines' as 'snipe, large and small,' whereas the correct translation would seem to be 'woodcock and snipe.' Here, too, 'Sandpipers' (*chevaliers*) should probably read 'Yellow-legs,' if not 'Dowitchers.'

Denys' natural history would be more interesting historically if we could always be sure what he was talking about, but in default of any such certainty we can get some amusement out of it as a sort of series of puzzle

problems. Professor Ganong has had his fun, and I have had mine. Perhaps somebody else would like to try his hand. Meanwhile we must thank Mrs. Elsa G. Allen for including Denys in her series of studies in the incunabula of American ornithology and thus reintroducing him to a world that had nearly forgotten him.

215 La Grange Street
West Roxbury, Massachusetts

REDISCOVERY OF THE MEGAPODE, *Aepypodius bruijnii*

BY R. MEYER DE SCHAUENSEE

Aepypodius bruijnii Oustalet, a large and very peculiar species of megapode, has long been a 'lost species.' The few specimens in existence are all known to have been collected by the hunters of A. A. Bruijn, a resident of Ternate in the Moluccas, who was engaged in the business of supplying feathers to the Paris plumassiers. When he got unusual or curious birds they were disposed of to museums. As his hunters often visited various localities on a single trip the authenticity of the places of origin which he ascribed to his specimens was notoriously inexact.

In 1879, the first specimen of *Aepypodius bruijnii* was sold, through Léon Laglaize, to Oustalet at the Muséum d'Histoire Naturelle in Paris. It was described in 1880 and its habitat was said to be the island of Waigeu, northwest of New Guinea. Bruijn's hunters managed to get a total of eleven specimens, but after that no more were seen. From Bruijn's day to this, *Aepypodius bruijnii* has remained a bird of mystery. Several expeditions have visited Waigeu, the last that of Georg Stein in 1931, and although the megapode was assiduously looked for, it was not found.

All this led to the natural conclusion that Bruijn's locality was wrong, that the bird had never come from Waigeu at all and must be looked for elsewhere, perhaps in the mountains of the Vogelkop on the mainland of New Guinea, on the island of Biak in Geelvink Bay, or in any other likely locality. Stein had carefully questioned the natives of Waigeu and they had answered quite positively that only one megapode (*Megapodius f. freycinet*) was known to them and that they had never seen or heard of a bird like *Aepypodius*. The latter is so distinct from *Megapodius* that they could not possibly confuse it, for it has a long wattle hanging from the neck and two additional ones hanging from the back of the head and besides, it is much larger (for colored plate see 'Annales des Sciences Naturelles,' Zool., 1881, pl. 33). This evidence seemed so positive that in the 'Check List of the Birds of the World' Peters said, "Range unknown, probably not Waigeu," and that voiced the feelings of everyone interested in the bird.

Last autumn the Academy of Natural Sciences in Philadelphia sent a native collector to Waigeu. He had been trained for a year and a half by the Denison-Crockett Expedition, which had made a trip to New Guinea for the Academy. The Academy needed a collection of Waigeu birds so when Joseph Kakiaij was sent, he was told to look for certain things, among which was a megapode with wattles. This was said more as a wishful thought than in the real hope that he would find it. The collection finally arrived this October, and among the last birds unpacked was a large black-

ish bird with chestnut and gray under parts, and wattles. It was *Aepypodius bruijnii*, the first specimen in over fifty years, and it proved that Bruijn's locality was correct.

There are in all twelve known specimens: two in Paris, one in the British Museum, one in the Turati collection in Italy, seven in the Rothschild collection in New York and now one in the Academy of Natural Sciences.

The bird must be very rare and shy for in all there have been ten expeditions to Waigeu, and until Joseph Kakiaij secured the present specimen no one but the hunters of Bruijn succeeded in getting it.

Academy of Natural Sciences
Philadelphia, Pennsylvania

SEX RATIO IN WILD BIRDS

BY E. A. McILHENNY

ORNITHOLOGISTS generally concede that there is considerable variation in the sex ratio of some species of wild birds. The cause of this variation from the normal 50-50 ratio to be expected in vertebrates has never been determined. My observations of birds in the field, of birds trapped in large numbers for banding, and of young birds before they leave the nests, lead me to believe that positive determination of the sex ratio can only be obtained by a thorough study of the nestlings, and then only where the full, average complement of eggs is hatched and the sex of the entire brood established. Determinations of this character are difficult with most birds, for, generally speaking, there is little or no external difference between the sexes as nestlings.

The object of this paper is to present definite data gathered through a five-year period showing: first, that there is a wide difference in the sex ratio of certain birds trapped and banded in large numbers at Avery Island, with but little variation in this ratio from year to year; second, that there is a large variation between the sexes in two species nesting and resident in the Avery Island territory in which the sex can be easily distinguished in the young birds long before they leave the nests. While no definite conclusion can be stated at this time as to why these unequal sex ratios exist, it is here very definitely proved that they do exist, and the information given may assist the laboratory biologists in reaching a definite conclusion.

Both of the species in which the sex determination was made as nestlings, belong to the family Icteridae. One is non-pairing, and has a surplus of females; the other is monogamous, and has a surplus of males. In both of these species it is easy to distinguish the sex by sight, five or six days after hatching.

One of the unsolved problems of genetics is what determines sex. In vertebrates, the expected sex ratio is 50% males and 50% females. There are, or course, exceptions to this general rule, but why there should be any wide deviation from it is a mystery. In order to simplify the comparisons presented at this time, let us classify them into two groups: primary and secondary. The primary group relates to the sex of the individual at the time of hatching. The secondary group covers the sex of the birds after leaving the nest and during adult life. The primary comparison is definite. The secondary comparison tends to prove the primary comparison, but may be full of errors, as will be shown later.

For more than twenty-five years I have operated a bird-banding station at Avery Island, Louisiana, using, first, the bands of the American Bird-

banding Society, and, when that organization and its records were taken over by the Biological Survey in 1921, then using the bands furnished by this bureau of the United States Government. The objects of bird banding are: (1) through the retaking of banded birds to learn their migration routes; (2) to learn their span of life; (3) to learn the proportion of the sexes of the birds banded.

A daily record of all birds banded at my station, giving the number of the band affixed, the date, species, and sex, is sent to the Biological Survey on Monday of each week, covering the banding of the preceding week. Complete duplicate records are kept in my office in two sets of books: one for wildfowl and gamebirds, and one for non-gamebirds. It is, therefore, quite easy to record a return band in the right book, in the right place, within a few minutes after the return record is received. As my records show full data on more than 150,000 birds banded, and record more than 15,000 returns, there is available a vast amount of valuable material concerning certain phases of the life history of birds that have been banded in large numbers yearly over a considerable number of years. All comparisons recorded here, tabulated, cover the five-year period 1934–38 inclusive, and no record is made where less than 500 birds of a species have been banded.

Although the utmost care may be taken by field observers in making comparative estimates of the sex ratio in birds as they see them, such observations are liable to be in error because of conditions unknown to the observer, for there is at times a segregation of the sexes in some species, and there often is a very close similarity of plumage of both sexes in the juvenal stage. For instance: if one were observing bird life on the Arctic coast of Alaska in the early summer, great numbers of female Red Phalarope (*Phalaropus fulicarius*) would be seen along the beaches and in flocks along the tundra lagoons. Very few males would be observed, and these only in small groups by themselves or as scattered individuals. One not understanding the habits of this bird would naturally think the females greatly exceeded the males. The reason for this seeming difference in sex is that the phalaropes arrive at the Arctic coast mated, and at once proceed to the tundras where nesting sites are selected. The female deposits her clutch of eggs, and at once turns the nest and eggs over to the male, who, from that time on, takes sole charge. The females go to the beaches of the ocean and large lagoons, where they gather in great numbers. The males are almost all inland, bringing up the family. The females leave for the south before the young are able to fly. The males and young make their southern migration a considerable time after the females. There is no mingling of the sexes until the next mating season.

A similar case arises with the King Eider (*Somateria spectabilis*). As soon as the females have deposited their clutch of eggs, the male birds leave

their mates and congregate in great numbers in the Arctic Ocean above shoals on which small clams abound, that, at this season, are the only food of these birds. The males lose, at this time, all flight feathers, and may be seen in flocks of many thousands covering comparatively small areas, with almost no females in evidence. From my observation I would judge there would not be ten females to a thousand males in one of these great flocks. At this time, the females are far out on the tundra raising their families.

Generally, in the observations of the field naturalist and sportsman, the male bird attracts more attention than does the female. This is especially true in ducks, where there is a wide difference in plumage. During many years of active duck-shooting, I have always killed males almost to the exclusion of females. I have done this so continuously, and for such a long time, that when hunting ducks and a flock comes within range, I actually do not see the females. My attention is riveted on the male or males that I expect to shoot. Anyone seeing the bags of ducks killed by my gun would naturally suppose that the males greatly outnumber the females. This, however, is not always the case. I remember on one occasion when shooting Mallards (*Anas platyrhynchos platyrhynchos*), the sex ratio of which is very even, I made a bag of fifty males and one female. This one female was killed by accident, as it crossed the line of fire intended for a male. I could have just as easily killed all females.

It is also a fact that in a number of our smaller birds, migration of the males and females occurs at different times, and in some species flocks of migrating individuals are composed of one sex or the other almost entirely. This is especially true of Bobolinks (*Dolichonyx oryzivorus*), Cowbirds (*Molothrus ater ater*), and the smaller grackles (*Quiscalus quiscula quiscula* and *Quiscalus quiscula aeneus*). Sight determination of sex ratio in birds, therefore, is likely to be faulty.

The most definite sex ratio I have been able to determine up to now is the primary ratio found in an examination of a large number of nestlings of species in which the young birds show a marked sex difference a few days after hatching, and several days before they are strong enough to leave the nest. Fortunately, we have here at Avery Island two resident birds, both of which not only nest in this vicinity in large numbers, but are present at all seasons in almost unbelievable numbers. These two birds are of unusual interest for a comparison of their sex ratio: first, because both belong to the family Icteridae; second, because the normal clutch of eggs laid by both is three; third, because in one, the females outnumber the males, and in the other, the males outnumber the females; fourth, because both are resident at the place of comparison, and abundant at all times; fifth, because the sex of the young is easily distinguishable five days after hatching; sixth, because the males in both species do not breed until the second year after hatching;

seventh, because the females in both species breed the first year after hatching; eighth, because both species have been banded as nestlings for many years, and a record was kept of the sexes; ninth, because both species have been trapped and banded every month in the year for many years; tenth, because in every instance where these birds banded as nestlings have been retrapped, or retaken by other means, the sex of the retakes has proved correct when checked with the recorded sex as nestlings. These two birds are Boat-tailed Grackle (*Cassidix mexicanus major*) and Gulf Coast Redwing (*Agelaius phoeniceus littoralis*).

The nests of *Cassidix* are easy to locate, as this bird breeds in colonies of sometimes more than two hundred nests. The nests of *Agelaius* are more difficult to locate because they are scattered, but my game keeper has no trouble in finding fifty or more each spring in the rushes along the edges of my shooting ponds. A conspicuous white card is tied to the grass or foliage at each nest under observation, and on this card all interesting observations for the particular nest are kept.

In my paper 'Life History of the Boat-tailed Grackle in Louisiana' (Auk, 54: 291, 1937) I gave the sex determination of the young in 89 nests of this bird, all observed during 1936. Of these nests, only 37 contained full complements of three young each. I now give the sex determination of 137

PRIMARY SEX DETERMINATION OF NESTLING BOAT-TAILED GRACKLE

Year	No. of Nests	Male	Female	Percentage Male	Percentage Female	Ratio Male	Ratio Female
1935	14	12	30	28.5+%	71.4+%	1 to	2.5+
1936	37	34	77	30.6+%	69.3+%	1 to	2.26+
1937	29	24	64	27.2+%	72.7+%	1 to	2.66+
1938	31	30	63	32.2+%	67.7+%	1 to	2.06+
1939	26	25	53	32+%	67.9+%	1 to	2.12+
Total	137	125	287	30.3+%	69.6+%	1 to	2.51+

There can be no error in the sex determination of these nestlings, as the sex of the young can be easily distinguished long before they leave the nests.

SECONDARY SEX DETERMINATION OF TRAPPED AND BANDED BOAT-TAILED GRACKLE

Year	Male	Female	Percentage Male	Percentage Female	Ratio Male	Ratio Female
1934	115	225	33.8+%	66.1+%	1 to	1.36+
1935	416	609	40.5+%	59.4+%	1 to	1.46+
1936	419	770	35.2+%	64.7+%	1 to	1.83+
1937	299	1052	22.1+%	77.8+%	1 to	3.51+
1938	519	909	36.3+%	63.6+%	1 to	1.75+
Total	1768	3565	33.1+%	66.8+%	1 to	2.01+

Comparison of Totals and Averages

	Male	Female	Percentage Male	Percentage Female	Ratio Male	Ratio Female
Primary	125	to 287	30.3+%	69.6+%	1 to	2.29+
Secondary	1768	to 3565	33.1+%	66.8+%	1 to	2.01+

nests in which the full complement of three young matured, as recorded in the five-year period 1935 through 1939, both inclusive.

The comparison of sex in the trapped birds shows a considerably lower percentage of males than that proved by the records of the nestlings examined. This is an error, and one that would not be known to anyone studying the comparison as recorded month by month. This is where the field observations, if properly analyzed, are of great value. At certain times of the year, flocks of *Cassidix* are composed entirely of males or of females. If a full-plumaged male is left in the trap to act as a decoy, nothing but males will go to that trap. If a female is left in the trap for a decoy, both males and females go to the trap.

During sixteen days in 1935, sixteen days in 1936, sixteen days in 1938, and four days in 1939, male birds were used for decoys. During those days, 940 males and 1,025 females were banded or one male to 1.06 females,

Primary Sex Determination on Nestling Gulf Coast Red-wing

Year	No. of Nests	Male	Female	Percentage Male	Percentage Female	Ratio Male	Ratio Female
1935	12	28	8	77.7+%	22.2+%	3.54+ to	1
1936	26	61	17	78.2%	21.8%	3.58+ to	1
1937	29	67	20	77%	23%	3.34+ to	1
1938	38	87	27	76.3+%	23.6+%	3.21+ to	1
1939	35	79	26	75.2+%	24.7+%	3.04+ to	1
Total	140	322	98	76.9+%	23.3+%	3.3+ to	1

There can be no error in the sex determination of these nestlings as the sex of the young can easily be distinguished from the time they are *five days old.*

Secondary Sex Determination on Trapped and Banded Gulf Coast Red-wing

Year	Male	Female	Percentage Male	Percentage Female	Ratio Male	Ratio Female
1934	448	66	87.1+%	12.8+%	6.78+ to	1
1935	629	161	79.6+%	20.3+%	3.9+ to	1
1936	968	239	80.2%	19.8%	4+ to	1
1937	1821	282	86.5+%	13.4+%	6.46+ to	1
1938	1607	259	86.1+%	13.8+%	6.2+ to	1
Total	5473	1007	84.4+%	15.5+%	5.43+ to	1

COMPARISON OF TOTALS AND AVERAGES

			Percentage		Ratio	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
Primary.....	322	98	76.9+%	23.3+%	3.3+	to 1
Secondary.....	5743	1007	84.4+%	15.5+%	5.43+	to 1

causing an apparent error in the sex ratio of the banded birds for the days during which males only were used for decoys in the banding traps.

The primary ratio shows an excess of three males to one female. The secondary ratio shows 5.43 males to one female. The only way this excess of males recorded as banded birds can be accounted for is, that great numbers of Red-wings come to the Gulf Coast during the winter from their breeding grounds in the North, and the excess of males in the northern breeding birds may be greater than that of those nesting on the Gulf Coast. Another cause may be due to the habit of Red-wings to flock at times according to sex. Often the banding traps catch nothing but males, but at no time have I found a surplus of females in the traps.

Both *Cassidix* and *Agelaius* belong to the family Icteridae, both have many common characteristics, such as food, nesting, number of eggs to clutch, and habits, but differ widely in sex ratio. They are excellent examples for the laboratory biologist to study, in an attempt to solve the reason for the unequal sex ratio in birds.

Other of the smaller birds banded in numbers as adults during the five-year period 1934–38, both inclusive, in which the sexes are distinguishable at sight are Eastern Cowbird (*Molothrus ater ater*) and Louisiana Cardinal (*Richmondena cardinalis magnirostris*). In this period a total of 4,281 Cowbirds were banded with a sex ratio of 73.8+% males to 26.1+% females or 2.82+ males to one female. This comparison is likely to be in error because at times flocks of Cowbirds are composed of either all males or all females.

Of 319 Cardinals banded, 209 were males and 110 females, or 65.5+% males to 34.4+% females or 1.9+ males to one female. The sexes of these two birds are so easily distinguished that there is no chance for error in the banding record.

I also annually band large numbers of Blue Jays (*Cyanocitta cristata florincola*), Meadowlarks (*Sturnella magna argutula*), Starlings (*Sturnus vulgaris vulgaris*) and others, and make no attempt to divide the sexes, as it is impossible, with any degree of accuracy, to distinguish the male from the female in birds of the year.

A study of the sex ratio for the five years 1934–38, both inclusive, of such ducks as have been banded in considerable numbers at my station indicates that males outnumber females in all but one species.

A comparison of the records by months shows there is definite seasonal variation in the sex ratio; for the proportion of females to males is greater in the early autumn than later.

A study of the birds as trapped points to the conclusion that the females and young come south in advance of the adult males. The return of banded birds also tends to prove this difference in migration.

COMPARISON IN SEX OF AMERICAN PINTAIL (*Dafila acuta tzitzihoa*) TRAPPED AND BANDED AT AVERY ISLAND, DURING THE YEARS 1934–38

Months	*Male*	*Female*	*Percentage* *Male*	*Female*	*Ratio* *Male*	*Female*
January	2774	1271	68.5%	31.5%	2.18+	to 1
February	1339	562	70.4+%	29.5+%	2.38+	to 1
October	535	358	59.9+%	40.+%	1.47+	to 1
November	4744	3163	60%	40%	1.5	to 1
December	6129	2527	70.8+%	29.1+%	2.3+	to 1
All other months	188	84	69.1+%	30.8+%	2.23+	to 1
Total	15709	7965	66.35+%	33.64+%	1.98+	to 1

COMPARISON IN SEX OF RING-NECKED DUCK (*Nyroca collaris*) TRAPPED AND BANDED AT AVERY ISLAND, DURING THE YEARS 1934–38

Months	*Male*	*Female*	*Percentage* *Male*	*Female*	*Ratio* *Male*	*Female*
January	1456	409	78+%	21.9+%	3.55+	to 1
February	578	184	75.8+%	24.1+%	3.14+	to 1
October	0	0				
November	675	325	67.5%	32.5%	2.07+	to 1
December	1972	476	80.5+%	19.4+%	4.14+	to 1
All other months	30	11	73.1+%	26.8+%	2.72+	to 1
Total	4711	1405	77%	22.9+%	3.35+	to 1

COMPARISON IN SEX OF LESSER SCAUP DUCK (*Nyroca affinis*) TRAPPED AND BANDED AT AVERY ISLAND, DURING THE YEARS 1934–38

Months	*Male*	*Female*	*Percentage* *Male*	*Female*	*Ratio* *Male*	*Female*
January	370	192	65.8+%	34.1+%	1.92+	to 1
February	83	57	59.2+%	40.7+%	1.45+	to 1
October	2	2	50%	50%	1	to 1
November	2092	1143	64.6+%	35.3+%	1.83+	to 1
December	3016	1068	73.8+%	26.1+%	2.82+	to 1
All other months	198	133	59.8+%	40.1+%	1.48+	to 1
Total	5761	2595	68.9+%	31.0+%	2.22+	to 1

COMPARISON IN SEX OF BLUE-WINGED TEAL (*Querquedula discors*) TRAPPED AND BANDED AT AVERY ISLAND, DURING THE YEARS 1934–38

Months	*Male*	*Female*	*Percentage*		*Ratio*	
			Male	*Female*	*Male*	*Female*
March	204	100	67.1+%	32.8+%	2.4	to 1
April	1729	481	78.2+%	21.2+%	3.5+	to 1
May	380	150	71.69+%	28.3+%	2.53+	to 1
September	438	318	57.93+%	42+%	1.3+	to 1
October	1577	1182	57.13+%	42.86+%	1.33+	to 1
November	385	320	54.6+%	45.4+%	1.2+	to 1
All other months	449	314	58.84+%	41.16+%	1.43+	to 1
Total	5162	2865	64.3+%	35.6+%	1.8+	to 1

The Blue-winged Teal is one of the few ducks breeding in North America that winter principally south of our borders. A study of the sex proportion by months, and a study of the individual birds when banding indicate that females and young come south in the autumn before the males, and that the females go north in April as soon as paired, leaving the surplus males to follow later. These facts in the seasonal movement of this bird cause an error in the ratio of sex determination, but the total figures indicate clearly that the males largely exceed the females.

We now come to the sex comparison of two closely allied ducks, the sex ratio of which differs widely. Of the Common Mallard (*Anas platyrhynchos platyrhynchos*) I have banded during the five-year period 1934–38, both inclusive, 3,441 individuals. Of these, 1,728 were males, and 1,713 females, or 50.2+% males to 49.7+% females—almost the ideal ratio of 50% males to 50% females. This is the only duck coming to southern Louisiana in which the sex ratio is so nearly even.

We will compare the sex ratio of the Mallard with that of its near relative, the Mottled Duck (*Anas fulvigula maculosa*). This duck, although a resident of the Louisiana coastal marshes, does not come in considerable numbers to my traps. I have, however, banded 332 of them, of which 220 were males, and 112 females. This small number banded gives a percentage of 66.2+% males to 33.7+% females, or, 1.96 males to 1 female. Why there should exist this wide difference in the sex ratio of these two closely allied birds is a mystery, for which I can find no explanation.

A number of other ducks banded in considerable numbers during the five years 1934–38, both inclusive, show a liberal excess of males over females. The following table will show the sex ratio tabulated in form easy of comparison:

ANALYSES AND COMPARISONS OF TOTALS AND AVERAGES

Species	*Male*	*Female*	*Percentage*		*Ratio*	
			Male	*Female*	*Male*	*Female*
American Pintail.	15709	7965	66.35+%	33.64+%	1.98+	to 1
Ring-necked Duck	4711	1405	77%	22.9%	3.35+	to 1
Lesser Scaup Duck	5761	2595	68.9+%	31.0+%	2.22+	to 1
Common Mallard	1728	1713	50.2+%	49.7+%	1+	to 1
Mottled Duck...	220	112	66.2+%	33.7+%	1.96+	to 1
Wood Duck.....	594	354	62.6+%	37.3+%	1.67+	to 1
Green-winged Teal	315	135	70%	30%	2.33+	to 1
Canvas-back....	343	197	63.5+%	36.4+%	1.74+	to 1
Blue-winged Teal.	5162	2865	64.3+%	35.6+%	1.8+	to 1

A comparison of the sex ratio in the nine species of ducks I have banded in considerable numbers, shows a predominance of males in all except Mallards, with an average ratio of slightly more than two to one. This comparison is not accurate; nor can any banding record give the exact sex ratio for reasons of likely errors as explained above. I think, however, that the records given prove there is undoubtedly a considerable surplus of males in the species of ducks tabulated, excepting the Mallard.

In order to determine whether there was a difference in the longevity of the different sexes, a check was made of the number of individual returns of three species of ducks banded in large numbers that were shown, by the return records, to have been alive four years after the bands were affixed. Of Pintails, a total of 381 males and 149 females were alive at four years after banding, or, 2.5— males to one female; this does not differ greatly from the banding ratio of 1.96 males to one female. Of Lesser Scaup, four-year-old returns were: 123 males and 37 females, or 3.0— males to one female; the banding ratio for this species was 2.22— to one. The four-year-old returns for Ring-necks were: 129 males to 26 females, or 4.9 males to one female; the banding ratio for this species was 3.35— to one. All three of these comparisons show that a considerable percentage of males live longer than the females, indicating that the females have more hazards to overcome than the males.

Avery Island
Louisiana

A GENUS FOR *Eupetes caerulescens* TEMMINCK

BY JAMES L. PETERS

FOR many years an assemblage of Papuan Timeliidae has been united generically with *Eupetes* (type *Eupetes macrocercus* Temminck) of the Malay Peninsula, Sumatra and Borneo. A preliminary survey of the Timeliidae in the Museum of Comparative Zoölogy shows that this grouping is not correct, but that the Papuan birds are generically separable from *Eupetes* and that there is no name available. I therefore propose

Ptilorrhoa genus novum

TYPE, *Eupetes caerulescens* Temminck.

DIAGNOSIS.—Related to *Eupetes* but bill relatively much shorter, more decurved terminally, little wider than high; position of nostril more basal, the distance from its anterior edge to tip of culmen equal to or less than the distance from its anterior edge to the gape; tail slightly graduated, rectrices broad and obtuse; tarsus less than twice as long as middle toe without claw; entire feathering of head normal (not velvety); under tail-coverts normal; no bare skin about eye; no naked patches on sides of neck.

REMARKS.—*Eupetes macrocercus* is strikingly different from any of the species listed farther on: the feathers of the entire head are very short and velvety; there is a conspicuous naked patch on either side of the neck; the bill is practically straight and relatively flat, its width at the gape nearly twice its height at the highest point on the culmen; the rectrices are relatively narrow and more pointed terminally; the feet are very small in relation to the tarsus, which is twice as long as the middle toe without claw; the under tail-coverts are very short and decomposed.

The most noticeable point of similarity in the two genera is the extraordinary thick mat of feathers covering the lower back and rump.

The forms of *Ptilorrhoa* are:—

Ptilorrhoa caerulescens caerulescens (Temminck)
Ptilorrhoa caerulescens nigricrissus (Salvadori)
Ptilorrhoa caerulescens geislerorum (A. B. Meyer)
Ptilorrhoa caerulescens neumanni (Mayr and de Schauensee)
Ptilorrhoa castanotus castanotus (Salvadori)
Ptilorrhoa castanotus saturatus (Rothschild and Hartert)
Ptilorrhoa castanotus pulcher (Sharpe)
Ptilorrhoa castanotus bürgersi (Mayr)
Ptilorrhoa castanotus par (Meise)
Ptilorrhoa leucostictus leucostictus (P. L. Sclater)
Ptilorrhoa leucostictus loriae (Salvadori)
Ptilorrhoa leucostictus amabilis (Mayr)
Ptilorrhoa leucostictus mayri (Hartert)
Ptilorrhoa leucostictus sibilans (Mayr)
Ptilorrhoa leucostictus centralis (Mayr)

Cambridge, Massachusetts

GEOGRAPHICAL VARIATION IN THE CAROLINA WREN

BY GEORGE H. LOWERY, JR.

VERY little taxonomic attention has been given in recent years to the Carolina Wren, *Thryothorus ludovicianus*. However, in the course of generalized collecting in certain parts of the southern United States, I have assembled a fairly representative series of specimens. On the basis of this initial material, considerable geographical variation became evident, in addition to that which had been currently recognized. Later, through the generosity of several museums, particularly the United States National Museum and the Biological Survey, some four hundred specimens of this species have been made available for study and comparison.

The Carolina Wrens form an interesting but difficult group for study, because one must discriminate clearly between individual and geographic variation and many factors pertaining to seasonal plumage change and museum age must be taken into careful consideration. Examination of the group as a whole with ample material reveals significant differences which sporadic investigations fail to do. The former approach enables one to make distinctions much more clearly than would otherwise be the case.

I know of no species of bird in which seasonal wear of the plumage effects such a disastrous change in its coloration as in the Carolina Wren. Having only one molt annually, taking place in late summer, Carolina Wrens become bedraggled and faded often as early as March and are thus of little taxonomic value for making color comparisons. Breeding specimens are of no use whatsoever, except in those cases where the exposed-culmen measurement is a useful criterion in determining a geographical race. Even then the wear of the forehead feathers is apt to cause erroneous measurement of that part. I have handled specimens of *T. l. miamensis*, the darkest and richest colored of all races of Carolina Wrens, that were absolutely indistinguishable from similarly worn specimens of typical *ludovicianus*. There is also some evidence that museum specimens as they grow older, tend to fade to a lighter brown. Many of the old museum specimens examined in the present connection do not compare favorably with more recent specimens from the same areas.

Particularly valuable in studying these various factors affecting plumage color, was an excellent series of wrens kindly loaned by Dr. J. Van Tyne and the University of Michigan. Especially interesting were specimens shot in Tennessee and sent to Ann Arbor in the flesh. Some of these were washed thoroughly with soap and gasoline while the remainder were made up as they were received. On the specimens that were washed, careful notations were kept regarding the color of the plumage prior to cleaning.

The comparison of the two series aided by the notations inscribed on the individual labels is absolutely astounding. Some of the unwashed specimens, while not appearing to be dirty, stand out in marked contrast to those which were cleaned. It is thus evident that in a study of this particular group of birds, and doubtless others as well, the cleanliness of the individual specimens, seasonal wear, and possibly museum age are factors of primary importance and must be taken into consideration before undertaking a critical analysis of geographical variation. Specimens indicating any of the above-mentioned defects have not been considered in drawing the foregoing conclusions.

I wish to make grateful acknowledgments to the following individuals and institutions for the loan of valuable material: Dr. Harry C. Oberholser and the U. S. Bureau of Biological Survey; Dr. Herbert Friedmann and the United States National Museum; Dr. J. Van Tyne and the Museum of Zoology of the University of Michigan (including specimens from Dr. Max Peet's collection); Mr. C. C. Gregg and the Field Museum of Natural History; Dr. W. B. Davis and the Texas Coöperative Wildlife Station at the Texas Agricultural and Mechanical College; Mr. Charles H. Rogers and the Princeton Museum of Zoology; Dr. George M. Sutton and Cornell University; Dr. A. I. Ortenburger and the University of Oklahoma. For valuable advice on obscure points, I wish to thank Dr. H. C. Oberholser, Dr. J. Van Tyne, Mr. T. D. Burleigh and Mr. James L. Peters.

Measurements in this study have been made with dividers and a vernier caliper; the wing on a chord from the bend to the tip of the longest primary without straightening these feathers; and tail from the insertion of the middle pair of tail feathers to its tip. The other measurements were made also as advocated by Baldwin, Oberholser, and Worley in their 'Measurements of Birds' (Sci. Publ. Cleveland Mus. Nat. Hist., no. 2, October, 1931).

Capitalized color names are those of Robert Ridgway, 'Color Standards and Color Nomenclature,' 1912.

THRYOTHORUS LUDOVICIANUS LUDOVICIANUS (Latham)

Southern Carolina Wren

[*Motacilla Troglodytes*] γ Gmelin, Syst. Nat., ed. 13, 1, pt. 2: 994, 1789 (based on *Troglodyte de la Louisiane* Buffon, Hist. Nat. Ois., 5: 361; *Roitelet, de la Louisiane* D'Aubenton, Pl. Enl., 6: pl. 730, fig. 1).

[*Sylvia*] *ludovicianus* Latham, Index Orn., 2: 548, 1790 (based on *Troglodyte de la Louisiane* Buffon, Hist. Nat. Ois., 5: 361; *Roitelet de la Louisiane* D'Aubenton, Pl. Enl., 6: pl. 730, fig. 1).

Thryothorus ludovicianus Bonaparte, Geog. and Comp. List, p. 11, 1838.

Thryothorus ludovicianus var. *ludovicianus* Baird, Brewer, and Ridgway, Hist. No. Amer. Birds, Land Birds, 1: 142, 1874.

T[*hriothorus*] *arundinaceus* Lesson, Rev. Zool., p. 263, 1840.

Thryothorus littoralis Vieillot, Nouv. Dict. d'Hist. Nat., 34: 56, 1819.
T[hriothorus] louisianae Lesson, Rev. Zool., p. 264, 1840.
Thryothorus ludovicianus alleghani H. H. Bailey, Bull. Bailey Museum and Library, no. 2, pp. 1–3, June 1, 1924.

Subspecific characters.—A medium-sized wren; upper parts averaging mahogany red; under parts Ochraceous Buff, being decidedly paler than either *T. l. miamensis* Ridgway, *T. l. berlandieri* Baird, or *T. l. euronotus* mihi; superciliary stripe variable but averaging nearly white; sides and flanks seldom, if ever, barred or tinged with brown.

Measurements.—Adult male (sixty specimens): wing, 55.0–62.9 (average, 60.1) mm.; tail, 47.0–54.0 (49.0); exposed culmen, 15.0–17.9 (15.9); tarsus, 19.8–23.0 (21.1); middle toe, 16.0–20.6 (17.8). Adult female (forty-seven specimens): wing, 53.8–59.2 (average, 56.5) mm.; tail, 44.0–49.2 (47.8); exposed culmen, 13.6–16.8 (14.8); tarsus, 19.0–22.5 (20.8); middle toe, 16.0–19.7 (17.5).

Range.—Southeastern United States from eastern and middle Texas, western and middle Louisiana, and central and southern Arkansas, east through central and northern Mississippi, Tennessee, southern Kentucky, northern and central Alabama and Georgia into South Carolina and North Carolina.

Specimens examined.—In all, 140: *Louisiana* (Belcher, Lecompte, Belair, New Orleans, Foster, Clarks, Natchitoches, Avery Island, Tunica, Baton Rouge, University, Jackson, Sulfur, Golden Meadow, Little Chenier, Alexandria), 38; *Mississippi* (Tishomingo County, Ariel), 3; *Alabama* (Catherine, Muscle Shoals, Ardell, Jackson, Carleton, Stockton, Hayneville), 9; *Georgia* (Newton, Athens, Blakely, Roswell, Waynesboro, Lumpkin, Tifton), 11; *South Carolina* (Georgetown, Wayne's Place, Bowman, Porcher's Bluff, Saluda Gap, Christ Church Parish, Kershaw County), 14; *North Carolina* (Pisgah National Forest, Chapanoke, Ashville, Cape Hatteras, Wilson, Fort Macon, Bath, Manteo, Mt. Mitchell), 19; *Tennessee* (Norris, Tazewell, Watauga Valley, Maynardville), 21; *Texas* (Bowie County, Riverside, Huntsville, Livingston, College Station, Jefferson, Bastrop, Virginia Point, Bryan, Sour Lake, Trinity County, Austin, Columbia, Eastland, Matagorda, Crystal City), 25.

Remarks.—In view of the wide distribution of wrens heretofore referred to as *Thryothorus ludovicianus ludovicianus*, it was obviously necessary to decide to which geographical stock Latham's name best applied. The term "Louisiana" has for a long time sufficed as the type locality of *T. l. ludovicianus*. However, in the days of Latham Louisiana covered pretty much the same area incorporated in the Louisiana Purchase, a fact lost sight of possibly in modern works of zoögeography when one is apt to think of Louisiana as merely the present State. As it is probable that earlier specimens of Carolina Wrens, and hence the type, came from New Orleans or environs, I restrict the type locality of *T. l. ludovicianus* to that area. Still further, to avoid possible confusion with races herein described or referred to, topotypes may best apply to birds taken *along the Mississippi River at New Orleans*. The incorporated limits of the City of New Orleans comprise the entire Parish of Orleans and in an eastward direction extend some thirty miles from the city proper, carrying one into the pine-woods

region bordering the Mississippi state line and the eastern shores of Lake Pontchartrain where another distinct geographical race is to be encountered. Birds from along the Mississippi River at New Orleans present the maximum individual variation within the race which they typify.

The use of H. H. Bailey's *Thryothorus ludovicianus alleghani* (loc. cit.), with type locality in Cobb County, Georgia, seems out of the question. In the first place Bailey used Washington, D. C., Maryland, and South Carolina specimens as representatives of *T. l. ludovicianus* (Latham), whereas he should have used topotypical Louisiana specimens. As will be shown later, birds from Washington, D. C., and Maryland are not referable to *T. l. ludovicianus*. For this reason and since birds from the lower Alleghanies and the Upper Piedmont region are nearly typical *ludovicianus*, it was not difficult for Bailey to show how they differed from the northern birds. The new name was given to the wrong series of birds! Had he used Louisiana material it would have been evident which series needed to be named. Birds from middle and eastern Texas (College Station, Huntsville, Austin, etc.) are not exactly typical and undoubtedly represent intergrades as do birds from still farther west. Since they appear closer to this form they are included here.

Thryothorus ludovicianus euronotus new subspecies

Southeastern Carolina Wren

Type.—Adult male, no. 342079, U. S. Nat. Mus., Biological Survey collection; Gulfport, Mississippi; November 20, 1937; T. D. Burleigh; original number 4798.

Subspecific characters.—Resembling *T. l. miamensis* Ridgway from which it differs in being smaller (size difference of exposed culmen absolute, judging from specimens examined) and by its somewhat lighter and less rich coloration; from *T. l. ludovicianus* (Latham), it differs in being decidedly darker.

Measurements.—Adult male (eight specimens): wing, 59.5–61.8 (average, 60.6) mm.; tail, 48.0–52.5 (50.5); exposed culmen, 15.0–16.3 (15.7); tarsus, 21.0–22.8 (21.7); middle toe, 18.1–19.5 (18.7). Adult female (six specimens): wing, 55.0–57.0 (average, 56.4) mm.; tail, 45.0–49.8 (46.6); exposed culmen, 13.6–15.5 (14.6); tarsus, 20.0–21.8 (20.7); middle toe, 15.3–19.7 (17.5).

Range.—Central Gulf Coast region of southern Georgia, and extreme northern Florida, westward through southern Alabama, southern Mississippi and extreme southeastern Louisiana.

Specimens examined.—In all, 28: *Mississippi* (Saucier, Bay St. Louis, Gulfport, Deer Island), 9; *Georgia* (Okefinokee Swamp, Riceboro, Valdosta, Woodbine, Blackbeard Island, Darien, Savannah, Brunswick), 12; *Florida* (Milton, Gonzalez, St. Marks, Lake Iamonia), 5; *Louisiana* (Slidell), 2.

Remarks.—Ridgway (Bull. U. S. Nat. Mus., no. 50, part 3, pp. 545–546, 1904) called attention to the fact that birds from the Suwanee River region of northern Florida are neither typical *miamensis* nor *ludovicianus*. He further suggested the possibility that birds from this area were subspecifically distinct, but he did not make the separation, probably due to the lack

of sufficient material. I have seen all of the specimens which Ridgway reviewed as well as a fine series from the Okefinokee Swamp and other points in southern Georgia; moreover, an excellent series from southern Mississippi has been available. With this material at hand it immediately became apparent that the wrens occupying this wide coastal belt deserve nomenclatural recognition. Remarkable is the uniformity of coloration demonstrated in the specimens examined. While superficially the coloration of the upper parts particularly, appears somewhat intermediate between *miamensis* and *ludovicianus*, the tone is so different that it can be recognized at a glance. This fact, in addition to the smallness of the bill (less than in either *ludovicianus* or *miamensis*), forms in my opinion sufficient ground for its recognition.

Specimens from Savannah, Woodbine, Blackbeard Island, and other localities in eastern Georgia are intermediate between *euronotus* and *ludovicianus*. Similarly, birds examined from the extreme northern part of the Florida peninsula are intermediate between *euronotus* and *miamensis*. Intergradation with *ludovicianus* apparently also takes place in the pine-woods region of eastern Louisiana. Of a fairly large series of wrens examined from Baton Rouge, only one specimen suggests *euronotus*, hence the birds from that area are included in the range of *ludovicianus*. However, farther east at Slidell, two fresh fall specimens taken prove to be almost typical *euronotus*, thus bringing the range of that form well within the boundaries of Louisiana.

Thryothorus ludovicianus burleighi new subspecies

Burleigh's Carolina Wren

Type.—Adult male, no. 342080, U. S. Nat. Mus., Bureau of Biological Survey collection; Cat Island, Mississippi, nine miles offshore from Gulfport, Mississippi; February 24, 1937; T. D. Burleigh; original number, 4297.

Subspecific characters.—Similar to *T. l. ludovicianus* (Latham) to which it is most closely related, but differs in being somewhat duller and more sooty above and averaging slightly paler below; color of the pileum not a great d al duller than the back; barring of the tail less distinct than in *ludovicianus;* size not significantly different from *T. l. euronotus* but easily distinguished from that race on the basis of its lighter coloration.

Measurements.—Adult male (seven specimens): wing, 59.0–62.0 (average, 60.5) mm.; tail, 48.2–52.0 (50.0); exposed culmen, 15.4–16.5 (15.8); tarsus, 19.9–22.0 (21.4). Adult female (four specimens): wing, 56.1–58.0 (average, 57.7) mm.; tail, 46.0–48.5 (46.9); exposed culmen, 14.0–15.0 (14.7); tarsus, 20.0–21.0 (20.5).

Range.—Resident on the islands lying well offshore from the Mississippi Coast; known to occur on Cat Island, Ship Island, and Horn Island. Not improbably it will be found on certain of the islands off the Alabama and Louisiana coast as well.

Specimens examined.—In all, 11: *Mississippi* (Cat Island, 3; Ship Island, 2; Horn Island, 6).

Remarks.—This island race of the Carolina Wren can be by careful comparison recognized in either sex by its rather duller and more sooty upper parts. In coloration it is closest to *ludovicianus*, but aside from its insular isolation, the intervention of the dark race *euronotus* of the Mississippi mainland prevents it from coming into geographical contact with the Louisiana birds. Birds of Cat Island are but nine miles distant from the wrens found about Gulfport. However, it is extremely doubtful whether any wrens from the island ever attempt to reach the mainland by crossing this expanse of water. The coastal islands have sandy soil and are covered by an open growth of slash pine, with an undergrowth of palmetto. Such conditions, it is true, exist on the mainland but are entirely avoided by the Carolina Wren, which is limited in its habitat preferences by the thick swampy woods bordering the streams. On the outer islands, Burleigh's Wren is surprisingly common. Ship Island is twelve miles offshore and Horn Island is sixteen, these distances again over open water and probably thus limiting any movement of this sedentary species to the mainland. Deer Island is, at its western end, less than a mile offshore, and there, as expected, birds taken prove to be *T. l. euronotus*.

This new race is named for Mr. Thomas D. Burleigh, the veteran field ornithologist, who, by his observations and collections, has added so immensely to the knowledge of the ornithology of the Gulf Coast of the southeastern United States in the brief period of four years during which he has resided there.

THRYOTHORUS LUDOVICIANUS MIAMENSIS Ridgway

Florida Wren

Thryothorus Ludovicianus var. *Miamensis* Ridgway, American Naturalist, 9: 469, August 1, 1875 (type locality, Miami River, Florida).

Subspecific characters.—Most similar to *T. l. berlandieri* Baird of northern Mexico but decidedly larger (the largest of all races) and much darker and richer; upper parts rich chestnut to dark chestnut; under parts ochraceous tawny, barred with chestnut on the sides; superciliary stripe buff; barring on tail and wing averaging much darker than in other races; exposed culmen averaging over 17 mm.

Measurements.—Adult male (sixteen specimens): wing, 59.0–64.6 (average, 62.5) mm.; tail, 49.0–54.0 (50.8); exposed culmen, 17.0–19.0 (17.8); tarsus, 21.5–23.8 (22.7); middle toe, 17.5–21.0 (19.5). Adult female (seven specimens): wing, 56.4–59.0 (average, 57.8) mm.; tail, 47.0–48.0 (47.3); exposed culmen, 16.4–18.0 (17.0); tarsus, 22.0–23.5 (22.6); middle toe, 18.0–19.0 (18.2).

Range.—Peninsula of Florida, typical from Gainsville and Palatka southward.

Specimens examined.—In all, 45: *Florida* (Lake Kissimmee, Palatka, Gainsville, Shell Bluff, Lake Arbuckle, Istakpoga, Planter, Deep Lake, Ocklawaha River, Fort Gardner, Seven Oaks, Canal Point, Big Lake George, Silver Springs, New Smyrna, Manatee County, Bradford).

THRYOTHORUS LUDOVICIANUS CAROLINIANUS (Wilson)

Northern Carolina Wren

Certhia caroliniana Wilson, Amer. Ornith., 2: 61, pl. 12, fig. 5, 1810 (type locality, along shores of the Delaware thirty or forty miles below Philadelphia; type in Peale's Museum).

Subspecific characters.—Most closely related to *T. l. ludovicianus* (Latham), but decidedly lighter in color; upper parts Auburn Brown, never as dark as *ludovicianus;* superciliary stripe Light Buff; size about the same as *ludovicianus* except that exposed culmen averages slightly larger.

Measurements.—Adult male (twenty-eight specimens): wing, 58.0–63.8 (average, 60.9) mm.; tail, 47.5–54.5 (50.7); exposed culmen, 15.0–17.7 (16.4); tarsus, 20.0–22.8 (21.1); middle toe, 16.2–20.9 (18.2). Adult female (twenty specimens): wing, 54.5–58.0 (average, 56.7) mm.; tail, 45.0–51.0 (46.9); exposed culmen, 14.6–16.2 (15.2); tarsus, 19.5–22.0 (20.5); middle toe, 16.0–19.5 (17.7).

Range.—Northern portion of the Upper Austral Zone from southern Iowa east through Illinois, Indiana, Ohio, southern Michigan, southern Pennsylvania, Maryland, Delaware, middle northern Virginia and the Hudson and Connecticut valleys south to eastern Oklahoma, southern Missouri and extreme northern Arkansas.

Specimens examined.—In all, 121: *Washington, D. C.*, 31; *Maryland* (Laurel, Plummer Island, Piney Point, Oxen Hill, Brandville, Baltimore), 11; *Virginia* (Roselyn, Hampton, Norfolk, Four Mile Run, Cape Charles, Eastville, Ballston, Essex County, Falls Church, Pine Forest, Tidewater, Scott Run, Fairfax County), 37; *Pennsylvania* (Bellowsville, Beaver), 4; *Ohio* (Madisonville, Muskingum County), 3; *Indiana* (Wheatland, Knox County), 3; *Illinois* (Wabash County, "southern part," Henderson County, Olney), 6; *Michigan* (Erie, Long Point), 4; *Kansas* (Douglas County near Lawrence), 4; *Arkansas* (Vanburen, Clinton), 3; *Oklahoma* (Broken Bow, Idabel, Mt. Scott, Tulsa, Cleveland County, Kiowa Indian Agency, Cheyenne, Jay), 15.

Remarks.—For this northern form of the Carolina Wren, Wilson's name seems fully applicable. Although Wilson mentions (loc. cit.) South Carolina wrens under the name *Certhia caroliniana,* his description and drawing are unquestionably based on a specimen taken in southeastern Pennsylvania, "thirty or forty miles below Philadelphia." Hence this place becomes the type locality for the present race. Since this race is quite distinct from other races, it is surprising that it has not been recognized heretofore. In the large series examined, there seems to be much less individual variation than in most other forms, particularly *ludovicianus,* which is in effect the most variable of all.

Thryothorus ludovicianus oberholseri new subspecies

Oberholser's Carolina Wren

Type.—Adult male, no. 342081, U. S. Nat. Mus., Biological Survey collection; Del Rio, Texas, along the Rio Grande; December 30, 1938; Thomas D. Burleigh; original number 5439.

Subspecific characters.—Similar to *T. l. ludovicianus* (Latham) but decidedly darker and duller on the upper parts; under parts distinctly more buffy, but not nearly as dark as *T. l. berlandieri* Baird; sides and flanks sometimes barred with

Dusky Brown; in size like *T. l. ludovicianus*, and hence much larger than *T. l. berlandieri* or *T. l. lomitensis* Sennett; upper parts not much duller than pileum.

Measurements.—Adult male (three specimens): wing, 59.6–61.3 (average, 60.7) mm.; tail, 50.0–53.0 (51.7); exposed culmen, 15.0–16.1 (15.5); tarsus, 21.0–22.0 (21.5); middle toe, 17.7. Adult female (four specimens): wing, 53.8–59.0 (average, 57.0) mm.; tail, 45.0–49.0 (47.7); exposed culmen, 13.5–16.0 (15.3); tarsus, 21.0–21.5 (21.2).

Range.—Middle Texas from at least Junction in Kimble County, south to the Rio Grande; exact limits of the range imperfectly known.

Specimens examined.—Ten: *Texas* (Del Rio, Langtry, Junction, Mountain Home, mouth of the Devils River, mouth of Pecos River).

TEXT-FIG. 1.—Provisional map showing distribution of races of *Thryothorus ludovicianus* (Latham). 1, *T. l. ludovicianus;* 2, *T. l. euronotus;* 3, *T. l. burleighi;* 4, *T. l. miamensis;* 5, *T. l. carolinianus;* 6, *T. l. oberholseri;* 7, *T. l. berlandieri;* 8, *T. l. lomitensis.* Blank areas between ranges represent areas of intergradation or areas from which no specimens were available.

Remarks.—Additional specimens from critical localities in central Texas are necessary before the limits of this race can be fully stated. A fairly large series of specimens has been available from Austin, College Station, Huntsville, etc., and while some of these show certain characteristics of *T. l. oberholseri*, they are nevertheless more closely referable to *T. l. ludovicianus*. One specimen from Junction, Kimble County, is clearly referable to *T. l. oberholseri* which might indicate that this race occupies a consider-

able part of the juniper area west of Austin. Somewhat confusing are two fresh fall specimens from Kendall County (in Princeton Museum of Zoology collection) which are decidedly different from all of the 400 odd wrens examined in the present connection. They represent both sexes and are remarkably uniform in coloration which is very light above and below. As a matter of fact, the under parts, especially the belly, of these two birds are almost white. Due to the uniformity of the two specimens and the fact that they are in clean, unworn plumage, I hesitate to identify them subspecifically until other specimens from that locality can be examined.

Likewise, a specimen from Crystal City, Texas, a point lying some 200 miles northwest of Brownsville, is interesting. Although Hellmayr ('Catalogue of the Birds of the Americas,' Field Mus. Nat. Hist., zool. ser., 13: pt. 7, p. 155, Nov. 1934) referred this specimen to *T. l. lomitensis* Sennett, in my opinion it can by no means be construed as belonging to that race as it is much too large and rich brown in coloration, rather than the dull grayish brown of *lomitensis*. In fact, it probably represents an intergrade between *oberholseri* and *ludovicianus*. As indicated henceforth, ***lomitensis*** is a bird of the Lower Rio Grande Valley. When one views the great areas apparently uninhabited by Carolina Wrens bordering the Rio Grande above and below Laredo, the isolation of *lomitensis* becomes obvious. It thus seems highly improbable that *lomitensis* comes geographically in contact with other races thereby suggesting a factor which might be responsible for its clear-cut taxonomic characters. This new race is named for Dr. Harry Church Oberholser in further recognition of his work on the birds of Texas.

THRYOTHORUS LUDOVICIANUS BERLANDIERI Baird

Berlandier's Carolina Wren

Thryothorus berlandieri Baird, Rep. Explor. and Surv. R. R. Pacific, p. 362, 1858 (type from Boquillo, Nuevo Leon, northeastern Mexico; coll. U. S. Nat. Mus.).

Subspecific characters.—A small yet long-billed wren with exceedingly dark under parts which are usually heavily barred with brown or tawny on the sides and flanks; upper parts like *T. l. ludovicianus* and *T. l. oberholseri* but very much duller and more grayish.

Measurements.—Adult male (eight specimens): wing, 56.8–61.2 (average, 59.0) mm.; tail, 45.1–51.7 (45.9); exposed culmen, 15.8–18.2 (17.1); tarsus, 20.5–21.9 (21.5); middle toe, 17.6–20.0 (18.4). Adult female (seven specimens): wing, 54.2–58.7 (average, 55.4) mm.; tail, 45.0–47.3 (46.2); exposed culmen, 15.0–17.0 (16.4); tarsus, 19.8–22.0 (21.1); middle toe, 17.0–19.0 (17.8).

Range.—Northeastern Mexico, in the States of Nuevo Leon, western Tamaulipas, and northern Coahuila.

Specimens examined.—In all, 17: *Nuevo Leon* (Monterrey, Santa Catarina, Montemorelos, Rodriguez, Cerro de la Silla, Linares), 16; *Coahuila* (Sabinas), 1.

THRYOTHORUS LUDOVICIANUS LOMITENSIS Sennett

Lomita Wren

Thryothorus ludovicianus lomitensis Sennett, Auk, 7: 58, 1890 (type locality, Lomita Ranch, Hidalgo County, Texas).

Subspecific characters.—A small dull-colored wren similar to *T. l. berlandieri* but averaging duller on the upper parts and with the under parts decidedly paler; back usually dull grayish, Prout's Brown or Warm Sepia; superciliary stripe pure white; sides and flanks almost always barred as in *berlandieri*.

Measurements.—Adult male (two specimens): wing, 57.0–58.0 (average, 57.5) mm.; tail, 51.0 (51.0); exposed culmen, 15.7–16.4 (16.0); tarsus, 21.0–21.5 (21.2); middle toe, 19.0–20.0 (19.5). Adult female (three specimens): wing, 53.5–56.0 (average, 55.0) mm.; tail, 46.0–48.0 (47.0); exposed culmen, 15.8–15.9 (15.8); tarsus, 20.0–22.0 (21.0); middle toe, 17.0–18.0 (17.5).

Range.—Lower Rio Grande Valley in Texas and northern Tamaulipas.

Specimens examined.—In all, 13: *Texas* (Brownsville, Los Fresnos, Hidalgo, Cameron County unspecified), 10; Tamaulipas (Camargo, Matamoras), 3.

Museum of Zoology
Louisiana State University
University, Louisiana

GENERAL NOTES

A specimen of the Black-capped Petrel.—Mr. L. Dalencour, who last year reported to me the occurrence of the Black-capped Petrel (*Pterodroma hasitata*) in Port-au-Prince, Haiti, has recently forwarded to the U. S. National Museum, under date of August 1, 1939, the bill, wing and foot of a specimen secured at Lafond, inland from Jacmel, on the southern coast of Haiti. This occurrence at about the same season as that of last year is further indication of the possible breeding of this rare petrel in the mountains of Haiti.—ALEXANDER WETMORE, *U. S. National Museum, Washington, D. C.*

Another record of *Puffinus diatomicus*.—A finely preserved specimen of *Puffinus diatomicus* was secured in 1938 by Dr. G. Dallas Hanna from the Miocene diatomaceous shales of Lompoc, California. This constitutes the sixth known specimen, all from these deposits, five having been recorded by Loye Miller (Publ. Carnegie Inst. Washington, no. 349, pp. 111–112, 1925) in his original description of this species. This additional example, now in the Paleontology Collection of the California Academy of Sciences, is in a fairly good state of preservation. The imprint of the bones indicates but little sign of distortion; the head, cervical vertebrae and trunk, however, are too poorly preserved to be of much value. While there is little doubt as to the allocation of the specimen to the species *diatomicus*, it differs considerably in certain measurements from those given by Miller for the earlier-found specimens, thus indicating a greater range in variation. The length of the ulna is 72 mm. as compared with 75, 76 and 79 mm. The second phalangeal element measures 24 mm. as compared with 21 mm., and the foot measures 48 mm. against 53 mm. given by Miller. These differences are considerable but are still within the range of individual and age variations. Other measurements were found to be in close agreement with those of the earlier-taken specimens.—ROBERT T. ORR, *California Academy of Sciences, San Francisco, California.*

Young Great White Heron and Würdemann's Heron in the same nest.—On March 10, 1939, I visited the recently established Great White Heron Refuge, near Key West, Florida, with Earle R. Greene, the refuge manager. On several mangrove islands, known as Snipe Keys, we found a number of nests containing eggs and young in all stages of growth of both the Great White Heron (*Ardea occidentalis*) and Ward's Heron (*Ardea herodias wardi*). One nest was found with a young Great White Heron and a young Würdemann's Heron (*Ardea würdemanni*), both nearly full grown. The Great White Heron was somewhat more active than the Würdemann's Heron and tried to climb away from us as we approached for a photograph. Lack of time prevented our staying to see the parents of these birds, but we believe that one was a Great White Heron and the other a Ward's Heron.

The finding of mixed broods of herons in the Florida keys, where both Great White and Ward's Herons nest commonly, was reported by Holt (Sci. Publ. Cleveland Mus. Nat. Hist., 1: 1–35, 1928). At the time he made his study of the herons, in December 1923, he found three nests with mixed broods. I believe there has been no recorded mixed brood since then. The status of Würdemann's Heron has long been clouded with doubt and differences of opinion, but on March 10 we found several adult Würdemann's Herons in this same locality, which may indicate a regular cross-breeding between the Great White and the Ward's Herons.—HAROLD S. PETERS, *U. S. Biological Survey, Charleston, S. C.*

Snowy Egret nesting in New Jersey.—On July 9, 1939, the undersigned found the Snowy Egret (*Egretta thula thula*) breeding in Cape May County, New Jersey. The nest, composed of twigs and small branches, was situated in a holly tree about eight feet from the ground, and contained three well-feathered young about three weeks old which left the nest upon discovery, clambering among the upper branches. Two were captured, examined in detail, photographed and banded. Their skins were a pronounced green in color; the tarsi a lighter green with a yellowish cast showing on the sole of the foot and wrist. The mandibles were lead-gray, darker at tip. The lores of the larger bird were noticeably yellow, while those of the smaller bird were greenish yellow. The primaries were about two inches in length and showed *no* traces of the dusky tips always in evidence in the fledgling Little Blue Heron (*Florida caerulea caerulea*), but were absolutely white above and below. One adult bird was observed not far from the nest.

On a subsequent visit July 16, McDonald, together with Julian K. Potter and Harvey Moore, fellow members of the Delaware Valley Ornithological Club, captured one of the banded birds and confirmed the identification. On the occasion the two immatures were closely attended by an adult. The tarsi, on this date, were greenish yellow, as were the toes. The soles of the feet and back of tarsi were more pronounced yellow. The toe-nails were gray at base with a black tip. The upper mandible measured two and three-eighths inches and was bright yellow at base, gradually darkening to a blackish tip. The primaries, as on a week previous, were *pure white;* the wing measured fourteen inches. The iris was yellow, with the pupil black. Total length approximately sixteen inches.

Stone ('Birds of Eastern Pennsylvania and New Jersey,' p. 63, 1894) in discussing the breeding range of this species states, "formerly to New Jersey . . . a heronry having been visited by Mr. H. G. Parker as late as 1886." A search of available literature fails to reveal a published breeding record for this species in New Jersey since that date. It is most gratifying to welcome the return of the Snowy Egret to New Jersey as a breeding species, especially when one considers that but a short time ago it was on the brink of extinction.—Norman J. McDonald, Stephen Daly John A. Gillespie, *Associated Conservation Agencies, Delaware County, Pennsylvania.*

A heronry in northern New Jersey.—On July 22, 1939, I came across a pond located in the hills about a mile south of Lake Mohawk, New Jersey. Here I found five species of herons: Great Blue Heron (*Ardea herodias*), Little Blue Heron (*Florida caerulea caerulea*), Eastern Green Heron (*Butorides virescens virescens*), Black-crowned Night Heron (*Nycticorax nycticorax hoactli*), and American Bittern (*Botaurus lentiginosus*). Undoubtedly these birds nested here as nests were seen and young Great Blue Heron and Little Blue Heron were seen. I visited this pond five times in a period of two weeks and always the same birds were observed. It seems strange that these birds should be nesting in this section of New Jersey. I do not know of another place within 75 miles where there is such a heronry.—William F. Rapp, Jr., *Rutgers University, New Brunswick, New Jersey.*

Black Ducks nesting in tree holes.—On May 25, 1938, along Portobello Creek, near Maugerville, Sunbury County, New Brunswick, I found two nests of Black Ducks (*Anas rubripes*) in tree holes similar to those used by Golden-eyes and Wood Ducks in the same locality. One nest was in an old snag with the entrance hole about seven feet above the flood waters and contained eight eggs; the other was in the hollow trunk of a live maple tree about ten feet up and contained seven eggs. In both instances the incubating adult was flushed from the nest when we came

within a few feet in our canoe. Possibly the Black Ducks were forced into using tree holes because this area is flooded by melting snow and early rains each spring to a depth of three to five feet or more, and hence all suitable nesting cover is under water at that time.

A Black Duck was found incubating eight eggs in a nest built in an old Crow's nest about fifteen feet up and overhanging the water of Loder Creek, near Sheffield, Sunbury County, New Brunswick, on May 26, 1938. This may be another adaptation resulting from flood waters. It is believed that these constitute the first recorded instances of Black Ducks nesting in tree holes and old Crow nests.

Col. H. H. Ritchie, chief game warden of New Brunswick, and John Campbell, game warden, were with me when the above observations were made, and movies were taken of the adult bird flushing in each instance.—HAROLD S. PETERS, *U. S. Biological Survey, Charleston, South Carolina.*

Snow Geese near Philadelphia.—The apparent paucity of records for Snow Geese in Pennsylvania, especially in spring, prompts me to submit the following observation. On the morning of April 27, 1935, while returning from a walk along Naylor's Run, Upper Darby, Pennsylvania, I chanced to glance directly overhead and was astounded to see a small flock of eight Snow Geese (presumably *Chen hyperborea atlantica*), winging their way northward in V-formation at an altitude of about 800 feet. The birds were silent, uttering no sound while within my hearing. The brightness of the morning sun and blue depth of sky as a background, seemed to accentuate the snowy plumage and contrasting black wing-tips of the birds in a clear-cut and unforgettable picture.

While I can find only one published *spring* record for the Greater Snow Goose in Pennsylvania (Auk, 30: 336, 1913), several observers in the neighboring State of New Jersey have noted large April flocks: Carter near Boonton (Auk, 41: 472, 1924), Nichols at Troy Meadows (Auk, 50: 352, 1933) and Eynon at Union (Auk, 54: 532, 1937).

Nichols in an interesting discussion of the Snow Goose, comments on the rarity of records for a bird so easily recognized and suggests that this may be due to their passage at such great altitudes as seldom to be seen. In addition to this factor, Dr. D. J. Elliot (in Bent's 'Life Histories of North American Wild Fowl,' Bull. U. S. Nat. Mus., no. 130, p. 167, 1925) says that the Snow Geese "usually fly silently," which, if characteristic of their high migratory flights would make them still less conspicuous to the observer.—J. KENNETH TERRES, *Soil Conservation Service, Ithaca, New York.*

Homing instinct and prolificacy in the Duck Hawk.—During the spring of 1939 it was my good fortune to be able to make several trips into eastern Pennsylvania for the purpose of collecting nesting data on the Duck Hawk (*Falco peregrinus anatum*). I have often wondered what would be the effect of removing one or the other of the adults from the eggs. Would the other parent continue to incubate them? If a captured bird were released at some distance would it return to the same nesting site, and if so, how soon? In other words, I was curious to find out how strong and lasting is the nesting urge in a species which is usually so fearless as the Duck Hawk in the protection of its eyrie, and to find out how pronounced is the homing instinct in this species. In the experience described below it must be remembered that only one bird was involved, the female. It is quite probable that the male would show a different reaction under the circumstances described. Though no conclusions can be definitely drawn from this single incident, it is, I believe,

worthy of record as a clear example of the homing instinct in the Duck Hawk, and an indication of the dominance of a periodic instinct over that which may cause a bird to shun an environment which has been detrimental to its welfare, at least in the particular female described.

On May 6, 1939, I descended to an eyrie on a cliff near Towanda, Pennsylvania. I had already visited this eyrie a week earlier, and found four eggs in the same location as last year. In most of the nesting places with which I am familiar the eggs are laid on open ledges affording a clear view in all directions. At the present site, however, the eggs were deposited in a shallow cleft in the cliff wall. This cleft is roughly three feet by three feet, and about fifteen inches high. Beneath it is a ledge wide enough to stand on and running for fifty or more feet along the face of the cliff. The opening of the nesting cleft is at the breast level of a person standing on the ledge.

On the date mentioned, May 6, I descended to the ledge about ten feet to the side of the opening of the cleft. The day was heavily overcast and a very strong wind was blowing. This is certainly the reason that the female bird which, as it turned out, was incubating at this time, had not been alarmed by my descent. Her first intimation of my presence and mine of hers was when I appeared before the cleft blocking her way to freedom. I grasped her quickly, and taking off my sweater, bundled her up in it so that she could neither move nor see. Before leaving the ledge I noted carefully the position of the eggs (they were individually marked) in the nest. I then returned immediately to Cornell University where I confined my captive in total darkness to prevent her injuring herself.

On May 10 I returned again to the nest and noted that the eggs were warm and that their position had been changed, evidence that the male had undertaken incubation. On May 13, I visited the eyrie and found the eggs cold though their position had again been changed. Another visit on May 17 found the eggs cold, their position unchanged. Apparently the male had deserted the eggs in the absence of the female. I determined to release the female, and in the event that she would find her way back and perhaps attempt to incubate her spoiled eggs, I removed the set. This was to allow her to lay a new clutch if she so desired.

I banded the female and broke the second primary in the left wing so that I could identify her if I saw her again before the fall molt. She was released at Cornell University at 6 p. m. on May 18. She made off immediately in the direction of Towanda and did not turn or deviate during the time she was within the range of my field glasses. The distance between Towanda and Cornell is sixty miles over mountainous country. The hawk was hooded when I took her from the nesting locality, she had been kept in total darkness for nearly two weeks, and yet the moment she was released she set off unerringly in the direction whence she had been brought.

I made a visit to the eyrie on May 24, but saw no Duck Hawks. On May 28, Mr. James Fox of Washington, D. C., visited the nest and informed me that it contained one egg. I returned to the site on June 3 and found four fresh eggs, not in the old spot, but in a similar cleft just ten feet away from the old spot. At this time I had a clear view of the female; it was the same bird I had released, the broken primary in the left wing was easily seen, and even the band on the leg was occasionally visible. Only a week after her harrowing experience the female had returned to lay another set of eggs. It is interesting to note that these eggs were fertile, for three of them hatched on June 30. The fourth failed to hatch.

It is my opinion that the hawk found her way back to the home cliff on the day she was released or the day following, in order to enable her to lay fertile eggs within

a week of her release. It strikes me as phenomenal that the bird should return and lay a second set under these circumstances, particularly at such a late date. The first set of eggs was only slightly incubated.—WILLIAM A. WIMSATT, *11 Grafton St., Chevy Chase, Maryland.*

Early nesting of the Duck Hawk in Maryland.—In 'The Auk' for April 1939, was published my note concerning an early breeding record of the Duck Hawk (*Falco peregrinus anatum*) at Harper's Ferry, West Virginia (nest is on Maryland side of the Potomac River). In the spring of 1939 the record was even more unique. Three 4-weeks-old fledglings were removed from the nest on April 10 by Washington falconers. Allowing a period of 28 days for incubation and four days during which the set was being completed before incubation began, I might reasonably conclude that the eggs were laid about February 12, a full two weeks earlier than last year. Other nests in this region did not have eggs until the end of March and early April.—WILLIAM A. WIMSATT, *11 Grafton St., Chevy Chase, Maryland.*

Ruffed Grouse budding on western serviceberry.—On January 3, 1939, while driving down a narrow country lane in the woods along the South Branch of Park River, I observed a Ruffed Grouse (*Bonasa umbellus*) budding on the western serviceberry (*Amelanchier alnifolia*). The bird fed on the buds for ten minutes at a distance of about fifteen feet from the observer before it flew away. Dr. Wm. R. VanDersal in his book 'Native Woody Plants of the United States' (U. S. Dept. Agric. Misc. Publ., no. 303) in summarizing food-habit records for *Amelanchier alnifolia*, reports stomach records for the Sooty Grouse and Richardson's Grouse; observations for Columbian Sharp-tailed Grouse and Blue Grouse. He reports stomach records of the Ruffed Grouse feeding on the serviceberry (*Amelanchier canadensis*). The portion of the plant eaten is not indicated in the above records.

The U. S. Bureau of Biological Survey recently informed the writer that "we have no records of Ruffed Grouse feeding on *Amelanchier alnifolia*. *Amelanchier canadensis*, of course, is an important grouse food. It has been recorded in 43 stomachs examined by the Biological Survey."—ADRIAN C. FOX, *Park River, North Dakota.*

King Rail breeding in southern Ontario.—Although apparently uncommon everywhere throughout its range along the southern edge of Ontario, the King Rail (*Rallus elegans*) does breed sparingly in a few of our marshes from Lake St. Clair east to Toronto. The earliest account of its nesting was published by the late J. A. Morden and Mr. W. E. Saunders (Canadian Sports. and Nat., 2: 193, 1882) who stated that it was common at St. Clair Flats (in the extreme southwestern corner of Ontario) and bred there. A female with a set of thirteen eggs, taken at St. Anne's Island, Lake St. Clair, Lambton County, in May, 1882, by Mr. Saunders is still in his collection (Baillie and Harrington, Trans. Roy. Canad. Inst., 21: 32, 1936). Information on its present status at St. Clair Flats has not come to the attention of ornithologists, so far as we are aware.

On May 30, 1894, a second set containing ten eggs was discovered in Ontario at Point Abino, Welland County, near the eastern end of the north shore of Lake Erie, by Edward Reinecke (Oölogist, 12: 45, 1895) but no further light was thrown on its breeding range in Ontario for nearly thirty years.

During the summer of 1921, and again in 1926, the late Charles K. Rogers observed a female with her family of young near the 'cottages' on Long Point, Norfolk County, on the north shore of Lake Erie (Snyder, Trans. Roy. Canad. Inst., 18: 163, 1931) and thus a third breeding station became known.

The fourth and fifth localities at which this rail is known to rear its young in southern Ontario did not come to the attention of ornithologists until very recently, and both places (Toronto and Hamilton) lie at the western end of the north shore of Lake Ontario and represent a slight northward and eastward extension of the known breeding range of this species in the province. At Toronto, F. H. "Bill" Emery had the good fortune to see five dark immature birds of this species together in one of the marshes bordering the lower Humber River on August 22, 1938, and at Hamilton three dark immatures were seen together at a small cat-tail marsh on the Burlington Golf Course (at Aldershot) on August 6, 1939, by a party comprising George W. North and Oliver Hewitt of Hamilton and F. H. Emery, Dr. Richard M. Saunders, William W. H. Gunn and Douglas S. Miller of Toronto. Four days later, at the same marsh at Aldershot, D. Bruce Murray, Lloyd Slichter and the writer saw an immature bird accompanied by its parent.

The record of the King Rail breeding at Pelee Island, at the west end of Lake Erie (Jones, Wilson Bull., 24: 145, 1912) seems insufficiently conclusive and should be considered hypothetical until some supporting evidence is forthcoming.

Localities which mark the northernmost penetrations of this rail into southern Ontario, all of them somewhat north and east of its known nesting range, are: Crane Lake, Bruce County, where one was identified on July 31, 1931, by William C. Baker (Auk, 49: 100, 1932); Port Perry, Ontario County, where one was seen by Russell G. Dingman and the writer on April 21, 1923; and Ottawa, Carleton County, where one was shot (at Billing's Bridge) on May 7, 1896, according to Eifrig (Ottawa Nat., 24: 176, 1911).—James L. Baillie, Jr., *Royal Ontario Museum of Zoology, Toronto, Ontario.*

Status of the Upland Plover.—Supplementing my records on the status of the Upland Plover (*Bartramia longicauda*), already published in 'The Auk', I submit my 1939 report. Since 1921 I have taken this census over four widely separated tracts in Lancaster County, Pennsylvania, which is one of the most used breeding grounds east of the bird's original range—Saskatchewan and the prairie lands southward. These definite tracts, about two square miles each, are (A) in Penn-Warwick townships; (B) in Warwick-Manheim townships; (C) in Warwick township; (D) in Elizabeth-Clay townships. The census records to date are as follows:

	A	B	C	D	Total
1921 (August 4)	12	3	3	3	21
1922 (August 3)	8	9	1	4	22
1923 (August 9)	23–24	35–38	1	15–20	74–83
1925 (August 8)	1	3	0	1	5
1936 (August 4)	5	22	4	11	42
1937 (August 4)	11	28	1	17	57
1939 (August 3)	14	75	0	5	94

Dr. Alexander Wetmore of the Smithsonian Institution, who spent eighteen months in South America studying our migrant shorebirds (1926), attributes this increase entirely to protection in North America. He says he knows of no improved enforcement of the loose game-laws in Argentina or Uruguay where the Upland Plover spends the winter. Richard Pough, of the Audubon Association, found the bird being shot with other shorebirds in Barbados (1938). The writer was assisted in making these observations, by Frank T. Thurlow, Clifford Marburger, Samuel Beck and Kenneth Schmid.—Herbert H. Beck, *Franklin and Marshall College, Lancaster, Pennsylvania.*

Wilson's Plover in Massachusetts.—On May 25, 1939, in company with Messrs. Seymour H. Stone and Robert W. Puffer, I saw at Third Cliff, Scituate, Massachusetts, a plover that was unmistakably a *Pagolla wilsonia* and presumably, of course, *P. wilsonia wilsonia*. We had just been watching a Piping Plover, when Puffer called attention to a bird not far away which, as soon as we had got our glasses on it, we saw at once to have the long black bill, the medium-dark upper parts, and the white stripe over the eye that characterize Wilson's Plover. From the moment we got a square look at it there was not the slightest doubt of the identification, but this was still further confirmed by the note *whit*, which was uttered several times when, after a considerable chase, the bird took wing. Though none of us was familiar with Wilson's Plover, we do know both the Piping Plover and the Semipalmated Plover very well indeed, both by sight and by ear. This appears to be the fifth reasonably authentic record of the species in Massachusetts. Two are given in Forbush's 'Birds of Massachusetts' (besides what may, perhaps, be a doubtful sight record of a flock of twenty-five). The third is that of a bird taken by Oliver L. Austin, Jr., at Truro, June 26, 1929 (Auk, 46: 538, 1929), and the fourth that of one seen on the Lynn-Nahant beach, May 15, 1932, by Samuel A. Eliot, Jr., Ludlow Griscom, and S. G. Emilio (Auk, 49: 465, 1932).—Francis H. Allen, *West Roxbury, Massachusetts.*

The winnowing note of Wilson's Snipe.—Incidental to my observations of waterfowl in the Province of New Brunswick, I found Wilson's Snipe (*Capella delicata*) a common nesting bird in the area from Fredericton to St. John in the St. John River valley between May 21 and 28, 1938. Since I was working in the marshes most of the time, I had excellent opportunity to hear the peculiar winnowing note characteristic of this bird when in flight on the nesting grounds. During this eight-day period of observations I recorded this flight note at the following hours: 1 a. m. 7 a. m., 10 a. m., noon, 2 p. m., 5 p. m., 7 p. m., and 10 p. m.; this indicates that it may be used at practically any hour of the day or night during the nesting season. Snipes were observed to alight on dead snags and on a fence post in the area near Sheffield, Sunbury County, New Brunswick, during the same period.—Harold S. Peters, *U. S. Biological Survey, Charleston, South Carolina.*

Red Phalarope in Kentucky.—On November 15, 1938, the writer, while hunting ducks on the Ohio River near Carrollton, Carroll County, Kentucky, in company with Mr. Jacob P. Doughty, of Louisville, observed a Red Phalarope (*Phalaropus fulicarius*) swimming in the water very close to the Kentucky shore. We paddled on the bird which was shot by Mr. Doughty. I made up the skin which is now in my possession. The bird was sent to Dr. Josselyn Van Tyne, of the University of Michigan Museum at Ann Arbor, who confirmed the identification after comparing it with the specimens in the museum. As far as I can ascertain, this is the first record of this species for the State of Kentucky.—Burt L. Monroe, *207 N. Birchwood Ave., Louisville, Kentucky.*

Courtship note on the Laughing Gull.—Because there appears to exist practically nothing in our literature concerning courtship in the Laughing Gull, *Larus atricilla*, and since there is no reasonable chance of my supplementing the following observation, I wish to record a single ceremony as it was noted by Colvin Farley and the writer on May 12, 1935, an alternately clear and cloudy day, at Old Greenwich, Connecticut. A pair of this species was observed standing alone on the shore of Long Island Sound. The female (as ultimately determined) stood slightly in front of the male and rather suddenly began calling with characteristic cries,

except that each note (or double note?) was given as the bird tossed its head upward and far over its back. Twice the male took a step forward, but each time the female headed him off and continued calling. At about the thirty-fifth (counted) bob by the female, her companion began to toss his head too and call. For the first two or three bobs the male was not in rhythm, but his next three or four calls and bobs were each in unison with those of his mate. She thereupon postured and he at once climbed upon her back. Copulation lasted about ten to fifteen (estimated) seconds, during which the male seemed to maintain his position without the use of the bill. Thereupon the female appeared to throw him off and both birds became more or less motionless and completely silent.

Courtship actions continually impress one with the effectiveness of the symbolic actions which the birds use. This one is particularly interesting because the female initiated the ceremony with no other immediate stimulus (as far as the observers were aware) than the mere presence of her mate. In addition, it is worth noting that these gulls were still on migration, the nearest-known nesting colonies being roughly one hundred miles away.—Joseph J. Hickey, *New York City.*

An early figure of the Great Auk.—In the December 1939 issue of the 'Field Engineers' Bulletin,' of the U. S. Coast and Geodetic Survey, there is an article entitled 'The First Thousand Years of Finding New York,' by Thomas M. Price, Jr., which gives an interesting account of early voyages to America and describes the development of nautical charts and navigational methods, from early times to the present. In looking through this article, which is illustrated with a number of reproductions of charts, old and modern, my attention was at once attracted to a picture of two odd-looking birds, riding stiffly on waves which seemed as unreal as the birds themselves. This picture was reproduced from a book called 'The English Pilot,' which was a standard guide for voyages into American waters some two hundred years ago. Several editions of the book were published in London, the first in 1706, and I obtained from the Harvard University Library a copy of the 1742 edition, from which the figure is reproduced herewith (Text-fig. 1). The descriptive matter

Text-fig. 1.—An early figure of the Great Auk (1742).

accompanying the picture of the "Pengwins" makes it evident that they were Great Auks (*Plautus impennis*) and that they were mentioned in the book because they were said to serve the mariner as an indication that he had reached the Newfoundland Banks. The compiler of the work comments: "I have read an Author that says, in

treating of this Coast, that you may know this by the great quantities of Fowls upon the Bank, *viz. Sheer-waters, Willocks, Noddies, Gulls* and *Pengwins*, &c without making any Exceptions; which is a Mistake, for I have seen all those Fowls 100 Leagues off this Bank, the *Pengwins* expected. It's true, that all these Fowls are seen there in great Quantities, but none are to be minded so much as the *Pengwins*, for these never go without the Bank as the others do; for they are always on it, or within it, several of them together, sometimes more, other times less, but never less than 2 together." The figure and account are referred to in a footnote in Grieve's work on the Great Auk, but seem worth reproducing in full. Unfortunately both birds in the picture are facing in such a way that only their right sides are visible, so that the reader cannot verify for himself the curious statement that they have "a Milk white Spot under one of their Eyes, which Nature has ordered to be under the right Eye, and Extraordinary remarkable: (for my part I never saw any with such a spot under their left Eye)." However, by turning to the front cover of 'The Auk,' one can readily see that the A. O. U. does not agree with this statement!—H. S. Shaw, *Exeter, New Hampshire.*

A detail in the ecology of the Mourning Dove.—During corn-cutting in September 1937, I noted an interesting and at times fatal habit of the Eastern Mourning Dove (*Zenaidura macroura carolinensis*). The birds occasionally roosted at night on cornstalks which had become bent over in such a manner as to allow them to perch with comfort. Being thus close to the ground, they were easily available to predators walking between the corn rows. In the eighteen-acre field I found that four of the birds had met their deaths as evidenced by the sufficiently conclusive amount of feathers in such locations. Near one of these spots were found the tracks of a fox.—Gordon W. Jones, *Wilderness, Virginia.*

Notes on Woodpeckers from West Virginia.—During field work for the U. S. National Museum in Kentucky in 1938, Mr. W. M. Perrygo, at my request, secured certain additional specimens from southwestern West Virginia. Notes on certain woodpeckers thus obtained, with observations on some specimens collected earlier, in 1936, follow.

Boreal Flicker, *Colaptes auratus borealis.*—Recent studies (Proc. U. S. Nat. Mus., 86: 191, 1939) have indicated to me that this race of flicker, though not recognized in the fourth edition of the A. O. U. 'Check-list,' is valid, with a breeding range extending from Labrador to Alaska, south to northern Minnesota and eastern Montana, and in migration to the States to the south. The wing in this race measures from 161 to 170 mm., a size considerably above that of *C. a. luteus.* In the collection made by Perrygo in West Virginia in 1936 there is one female taken at an elevation of 3000 feet on Flat Top Mountain, near Flat Top, on October 20, that is definitely this far-northern bird, present as a migrant, as it shows the following dimensions: wing, 163.0; tail, 103.0; culmen from base, 37.0; tarsus, 30.3 mm.

Eastern Hairy Woodpecker, *Dryobates villosus villosus.*—A specimen collected at Crum, July 7, 1938, has a wing measurement of 117.8 mm., which is rather small for the typical race but still within its limits.

Northern Downy Woodpecker, *Dryobates pubescens medianus.*—Females taken in Wayne County, one mile north of Wayne, July 5, 1938, and three miles north of Crum, July 7, 1938, have the wing 91.9 and 93.1 mm. respectively, thus agreeing with *medianus*, and adding further corroboration that this is the resident form in the southwestern part of the State.

In the original paper on the West Virginia collection of 1936 (Proc. U. S. Nat.

Mus., 84: 412, 1937) I listed one female with a wing measuring 99.0 mm., this being a bird taken at 3500 feet elevation on Williams River, October 5, 1936. My attention drawn to this again, I have checked this dimension more carefully to find that it should be corrected to 97.9 mm. The large wing might suggest that this is a migrant individual of *Dryobates p. nelsoni* but the dull white of the breast is quite different from the clear color of the more northern bird so that the specimen represents merely an individual of *medianus* of maximum dimensions.—ALEXANDER WETMORE, *U. S. National Museum, Washington, D. C.*

An odd nest of the Carolina Wren.—On April 18, 1938, I saw an unusual nest of the Carolina Wren (*Thryothorus l. ludovicianus*) in the foothills, twelve miles west of Lexington, Virginia. It was located in a small cedar in a ravine at the edge of open woods. The nest was saddled across several small branches near the trunk of the cedar, five feet from the ground. It was a round, flattened mass, six inches deep by nine inches across, completely domed over and with the opening in the side. The lower part of the mass was made of roots and grass, the upper part of green moss. It contained young birds, about one-third grown.—J. J. MURRAY, *Lexington, Virginia.*

Wood Thrush nesting in Montreal.—Subsequent to the publication of observations and notes by Dr. F. R. Terroux and myself, on the occurrence of the Wood Thrush (*Hylocichla mustelina*) in the Laurentian region, north of Montreal (Canadian Field-Nat., 51: 46, 1937) there has been a gradual extension of the range of this species in the Province of Quebec, and in view of its hitherto accepted distribution, additional data concerning this thrush are of interest. Since our discovery in May 1935, that Wood Thrushes were breeding in small numbers in the Laurentians, they have been found nesting, in succeeding years, on the Monteregian Hills, heavily wooded oases, rising above what is otherwise flat agricultural land east of Montreal. Early in June 1939, several were heard and seen on the Island of Montreal. On June 13, a pair was located on the eastern slope of Westmount facing Mount Royal Park, and on the next day I found the nest occupied by the female. It was built in a flowering hawthorn, approximately fifteen feet above the ground, and on June 20, another nest was discovered in the same locality by Mr. L. M. Terrill. Five days later both nests contained three young, thus establishing, as far as I know, the first breeding records of this species in Montreal.—J. D. CLEGHORN, *Redpath Museum, McGill University, Montreal, Quebec.*

Red-eyed Vireo captures food under water.—On July 16, 1934, the writer, while engaged in making a survey of the bird population of a tract of beech and sugar-maple forest near Cleveland, Ohio, noticed a Red-eyed Vireo (*Vireo olivaceus*) plunging into a shallow pool of water at the edge of a woodland brook. This unusual behavior was repeated several times. The bird would work down a small branch overhanging the pool until it was about eight inches above the water. Here attention was fixed at a certain spot in the water below, and shortly the bird would dive in head first as a kingfisher does. It would then fly to a perch in a tree about twenty-five feet away and eat something apparently captured from the water. Once the bird was nearly submerged and had to stop to shake the water off its plumage before eating the morsel. I had always considered the Red-eyed Vireo as among the more resourceful and adaptable of woodland birds, and the foregoing incident served to confirm this impression of the bird's character.—ARTHUR B. WILLIAMS, *Cleveland Museum of Natural History, Cleveland, Ohio.*

Nashville Warbler breeding in northeastern Illinois.—During observations in an oak-maple-hickory woodland along the Desplaines River, Deerfield Township, Lake County, Illinois, on June 14, 1938, a female Nashville Warbler (*Vermivora r. ruficapilla*) was located in a willow thicket bordering a small stream and was observed carrying food, giving an alarm note repeatedly and occasionally 'feigning injury.' Efforts were made to locate the nest but without success. At the same time, a male Nashville Warbler was heard singing from the trees bordering the semi-swampy area along the stream; it continued to sing throughout the time spent there. On June 17, a Nashville Warbler, probably the female, was seen carrying food near the original location, but did not give any alarm note. Movements in the surrounding shrubbery seemed to indicate that the young were out of the nest, but the difficulty of observation in the thicket prevented the writer from verifying this belief. On that date the male was not heard nor seen, but on the following day, June 18, the song was heard a few times during the morning from the same territory.

The breeding locality in northeastern Illinois was predominantly oak-maple-hickory climax woodland with semi-dense undergrowth, the whole being of a decidedly more mesic character than the usual oak-hickory upland woods found in the Chicago region away from Lake Michigan. However, it was no doubt the combination of this woodland with the stream cutting it and a semi-swampy, sedge-grass area with willow thickets and scattered elms and ashes that attracted the Nashville Warbler. In northern Michigan (June and July, 1938), the writer found this species in spruce and cedar bogs and in sandy woods of aspen, birch, and Norway pine bordering Douglas Lake (Cheboygan County). Literature indicates that the species has a wide tolerance of habitat factors, occupying ecologically developmental and relatively dry as well as climax and moist areas.

The earliest mention of the Nashville Warbler as a summer resident in Illinois is that of Ridgway (1874), who classified it as a "summer resident in the northern portion? transient in other parts" (1: 368, see references below). In 1876, Nelson listed the species as "a rare summer resident" for northeastern Illinois (2: 98). In 1881, Ridgway, removing the symbol of doubt, included the Nashville Warbler in his revised catalogue as a "summer sojourner northward, transient southward" (3: 174). The first account with complete data of its breeding within the State was published by Philo W. Smith, Jr. (4: 44); this account describes a single nest of the Nashville Warbler containing six eggs, found May 12, 1879, at the base of a hazel bush (probably *Corylus americana*) among the shrubs of the same species covering a clearing on an upland hillside. The reader is left in doubt as to whether or not the female was collected; the male was not seen. The last paragraph of Smith's account is most amazing, and the writer is able to quote it through the courtesy of Mr. R. M. Barnes of Lacon, Illinois, who provided a copy of the original article. "We secured 4 sets the same day. Up to the present date, I have secured *twenty* [writer's italics] sets of eggs of this Warbler . . . The average number of eggs in a set is 5; sometimes 4 and even 6 eggs are laid." The only subsequent reference to this record, strangely enough, was located in Butler's 'Birds of Indiana' (7: 1034). Ridgway's most exhaustive work on the birds of Illinois (1889) recognizes the Nashville Warbler as a summer resident in the "extreme northern counties" (6: 128); no mention is made of Smith's record in Fulton County, which is located in west-central Illinois, bordered on the southeast by the Illinois River. Unfortunately, Ridgway's generalizations on the occurrence of certain rather irregular and more or less uncommon species, unaccompanied by specific references, are of little value today. Kumlien and Hollister (1903) give a breeding record for Walworth County, Wisconsin (bordering McHenry

County, Illinois), of a male Nashville Warbler mated with a female Blue-winged Warbler; both birds were taken and eggs found (8: 110–111). They state further: "We have nesting records at different times in Walworth County, at Lake Koshkonong . . . ," the latter locality being about 25 miles north of Winnebago County, Illinois. Other publications treating in any manner the distribution of the Nashville Warbler in Illinois quote the above references and give no additional records; the former include the works of Cooke (5, 9), Woodruff (10), Cory (11), Gault (12), and Ford, Sanborn, and Coursen (13). Cory (11: 645) mentions nothing of the breeding of the Nashville Warbler in Illinois, but quotes Kumlien and Hollister (7) on the Walworth County record; the omissions seem to indicate that he did not regard previously published comments on the summer occurrence of this species in Illinois as bona fide breeding records.

The distributional references to the authorities mentioned above are listed as follows:

(1) Ridgway, R. Catalogue of the birds ascertained to occur in Illinois. Ann. Lyceum Nat. Hist. New York, 10: 364–394, 1874.
(2) Nelson, E. W. Birds of northeastern Illinois. Bull. Essex Inst., 8: 90–155, 1876.
(3) Ridgway, R. Revised catalogue of birds ascertained to occur in Illinois. Bull. Illinois State Lab. Nat. Hist., 1: 4: 161–208, 1881.
(4) Smith, Philo W., Jr. Nesting of the Nashville Warbler in Fulton County, Illinois. Bay State Oologist, 1: 44, 1888.
(5) Cooke, W. W. Bird migration in the Mississippi Valley. Bull. U. S. Dept. Agric., Div. Econ. Ornith., no. 2, 1888.
(6) Ridgway, R. Ornithology of Illinois. State Lab. Nat. Hist., Springfield, vol. 1, part 1, 1889.
(7) Butler, Amos W. Birds of Indiana. 22d Ann. Rept. Indiana Dept. Geol. & Nat. Resources, pp. 515–1188, 1897.
(8) Kumlien, L., and Hollister, N. Birds of Wisconsin. Bull. Wisconsin Nat. Hist. Soc., n. s., 3: nos. 1, 2, 3, 1903.
(9) Cooke, W. W. Distribution and migration of North American warblers. U. S. Dept. Agri., Biol. Surv., no. 18, 1904.
(10) Woodruff, F. M. Birds of the Chicago area. Chicago Acad. Sciences, Nat. Hist. Surv., Bull. 6, 1907.
(11) Cory, C. B. Birds of Illinois and Wisconsin. Field Museum Publ. no. 131, vol. 9, Chicago, 1909.
(12) Gault, B. Check-list of the birds of Illinois. Illinois Audubon Soc., 1922.
(13) Ford, Sanborn and Coursen. Birds of the Chicago region. Prog. Act. Chicago Acad. Sciences, 5: 2–3, 17–80, 1934.

With the exception of that from Fulton County, all records of this species as a summer resident in Illinois are confined to the northeastern portion, these being grouped with the records from southeastern Wisconsin in the Chicago region. As is evident from the above discussion, its occurrence during the breeding season is rare and local, the present breeding record being the first for that region since 1903 and the first for Illinois since at least 1888. Van Tyne's recent 'Check-list of the Birds of Michigan' cites a breeding record for Jackson County, the approximate latitude of which is the same as that of Lake County, Illinois. To verify Smith's Fulton County records, the writer would appreciate any information leading to the location of extant sets of eggs of the Nashville Warbler from Illinois.—FRANK A. PITELKA, *Experimental Zoology Laboratory, Champaign, Illinois.*

Two new breeding birds for the United States.—In the course of field work on avian ecology in the vicinity of Tucson, Arizona, there have been discovered breeding populations of two birds previously believed to nest only southward from the vicinity of Guaymas, Sonora, Mexico. Attention is now called to these in order that other ornithologists may be alert for their detection elsewhere in southern Arizona.

West Mexican Kingbird, *Tyrannus melancholicus occidentalis*.—This now stands in the A. O. U. 'Check-list' on the basis of a casual specimen taken in Washington in mid-November. It has been once recorded from Arizona, on the basis of a female taken at Fort Lowell, near Tucson, May 12, 1905 (Peters, Condor, 38: 218, 1936; cf. also Coues, Amer. Naturalist, 6: 493, 1872, and Bendire, Special Bull. U. S. Nat. Mus., no. 3: 244, "1895"). On July 14, 1938, I collected a pair of these kingbirds near Tucson, and later at least two or three other pairs were found and a third adult was collected. Three young apparently several days out of the nest (tails half to two-thirds grown) were found high in a cottonwood on July 31, and these were again noted August 1, 3, and later. The maximum of six or seven birds was seen August 19, when the young were foraging for themselves but still following the adults; a juvenile was collected for the record. On my next visits, on September 11 and during November, none was seen.

In 1939, none was seen during March and early April, nor on a rapid trip through a small part of the region on May 6. A pair was seen on May 27, and on May 30 two pairs were located and another bird was seen briefly. On June 2 one was carrying what appeared to be straws into a cottonwood, but no search was made for the nest. The other pair was again seen June 7; on July 15 they had almost full-grown young and the family group numbered five birds. This family was at practically the identical spot as the 1938 family. On August 26, 1939, and again on September 3, five birds, in three groups, were seen; the third group may well indicate an additional pair, previously overlooked, making a total of possibly four pairs present in the area covered in 1939. On September 10, none was seen. Bulk departure thus appears to occur early in September.

The call of this kingbird is strikingly different from those of the three northern kingbirds, being of a metallic rather than a throaty quality. It consists of a rapid series of short, staccato notes in an ascending, high-pitched series, and might be rendered as *pit—it—it—it—it-it-it-it-it*. In form the call somewhat resembles that of the Vermilion Flycatcher, but it is much louder, sharper, and higher-pitched. Besides the call, the heavy bill, whitish throat, bright yellow belly, and brownish, emarginate tail all help distinguish it in the field, and the tail characters are obvious in flight even at some distance. In spite of these several easy distinctions, it seems probable that the birds have been allowed to pass for Arkansas Kingbirds by the few ornithologists who have entered their restricted ranges in the summer months.

It seems evident that the West Mexican Kingbird is a regular summer resident at the present time near Tucson, from May 12 to September 3 at least. The numbers present are not great. The birds have been seen by a few other observers, also, including Dr. A. A. Allen, A. H. Anderson, Dr. Wm. L. Holt, F. W. Loetscher, Jr., and Gale Monson.

Sonora Grackle, *Cassidix mexicanus nelsoni*.—This bird has not previously been recorded north of Mexico. On June 23, 1938, with the aid of Messrs. Dean Amadon and Ben Tinker, I took a worn male in irrigated farmlands near Tucson. This was prepared by Amadon and proved to be almost in breeding condition. Later in the summer another male and a female were taken, and at least one or two other males

and another female were seen. Tinker saw a flock of nine in late July. A female was seen carrying nest material on June 27, but I could find no nests. On August 3, however, A. H. Anderson and I saw a female with a young bird able to fly fairly well (tail one-third to half grown). Since that date, so far as I can learn, no grackles have been seen in the Tucson region. Their failure to reappear in 1939 leaves their status doubtful.

There can be no doubt that grackles have only recently invaded Arizona. Mr. Claude Higgins, proprietor of the pool near which they nested, first saw them in 1937, when a male and two females were seen, the arrival being about April 10; in 1938 they arrived about April 25, and I saw two or three males, two females, and one young bird there. Tinker saw two males at his home between April 25 and May 1, 1938—their first appearance there. A total of ten was detected during the summer.

Gale Monson has recorded "Great-tailed" Grackles from Safford, Arizona (Wilson Bull., 48: 48, 1936; Condor, 39: 254, 1937). On examining my Tucson specimens, he concluded that these records referred to *nelsoni*, also; he has kindly allowed me to make this statement. The Sonora Grackle is apparently the only grackle validly recorded from Arizona as yet.

The grackles that have established themselves in recent years at Lordsburg, New Mexico, cannot yet be identified subspecifically. These birds seem to have a different status from the Arizona populations; the data given by Peterson (Condor, 41: 217, 1939) indicate much earlier nesting, and I saw about ten birds there as late as October 22, 1939. It may also be mentioned that my mother, Mrs. William X. Foerster, saw one there May 21, 1939, and I saw two on September 17, 1939. All these Lordsburg records were made during brief stops in passing, so they are not representative of the numbers present.—Allan R. Phillips, *University of Arizona, Tucson, Arizona.*

Parasitism of the Red-wing by the Cowbird.—With reference to the note on this subject by R. D. Ussher (Auk, 55: 545, 1938), Friedmann (The Cowbirds, p. 212) states that *Agelaius* is a "fairly common but rather local victim." On May 16, 1937, for the first time in Wisconsin, I found an egg of the Cowbird (*Molothrus ater*) in a nest of *A. p. arctolegus* at Crystal Lake, Dane County. Here the species nests commonly in willows, elderberry bushes, and saplings at heights of four to six feet. At this lake on May 15, 1938, two of the four nests examined were parasitized. One nest contained two eggs of the owner and two of the Cowbird; and the other contained two eggs of the owner and one of the Cowbird. All of the four nests had wool on their exterior. Wool was abundant on an adjacent barbed wire fence under which the sheep passed.—A. W. Schorger, *168 North Prospect Avenue, Madison, Wisconsin.*

New food habit for Common Redpoll.—The following food-habit observations on the Common Redpoll (*Acanthis linaria linaria*), being new records, are of interest: giant ragweed (*Ambrosia trifida*), October 1938, Bottineau, North Dakota; prairie sunflower (*Helianthus petiolaris*), January 1939, New England, North Dakota; marsh elder (*Iva xanthiifolia*), January 1939, New England, North Dakota.

The U. S. Biological Survey in recent correspondence relative to the above observations stated: "Our stomach-examination records do not show *Helianthus petiolaris, Iva xanthiifolia*, or *Ambrosia trifida* as being food of the Common Redpoll. *Ambrosia artemisiifolia*, however, has been recorded in 18 stomachs. Undetermined species of *Artemisia* have been recorded in 189 stomachs of the redpoll."—Adrian C. Fox, *Park River, North Dakota.*

Lark Bunting in Oregon.—On May 14, 1939, a male Lark Bunting (*Calamospiza melanocorys*) was seen along a country road north of Saddle Butte in Linn County, Oregon. It sat for nearly ten minutes on a fence a few yards from my car. It was about the size of an English Sparrow; the bill was large, finch-like, light bluish in color, the body color was black, slightly grayed on the back. There was a long white patch in the wing. The end of the tail was edged with white. It immediately called to mind the Lark Buntings I had known on the plains of Colorado. It was seen in a sparsely settled part of the Willamette Valley, and remote from the nearest farmhouse. The eastern side of the valley in this vicinity harbors a number of animals normally found in eastern Oregon, among them Burrowing Owls and Arkansas Kingbirds. So far as I know this constitutes the first record of the Lark Bunting for Oregon.—KENNETH GORDON, *Department of Zoology, Oregon State College, Corvallis, Oregon.*

Fieldfare, an addition to the American list, and some arctic notes.—From the hands of Mr. Graham Rowley, lately from the North, the National Museum of Canada is in receipt of two specimens whose importance warrants special record.

FIELDFARE, *Turdus pilaris.*—From the southeastern coast of Jens Munk Island at the head of Foxe Basin, Arctic America, was received a specimen of this bird, taken during the summer of 1939. It is a roughly made, semi-mummified skin but quite complete and recognizable. Mr. Rowley found it in the possession of an old Eskimo woman who recognized it as unusual and was keeping it as a curiosity. It appears to be the first record for the American list. The normal range of the species is in the Old World from Scandinavia to the Lena in Siberia and no subspecies of the species has been recognized. It is of casual occurrence in Iceland but, contrary to most similar European arctic strays to this hemisphere, it seems not to have been reported from intermediate stations in Greenland.

YELLOW-BILLED LOON, *Gavia adamsi.*—The skin was used by an Eskimo family as a hand towel and was too fragmentary for useful preservation, but the skull and bill are perfect. The specimen was taken just north of Hooper Inlet, Melville Peninsula, near the mouth of Fury and Hecla Strait, July 1939. This is the first evidence of occurrence of the species east of the Boothia Peninsula where it was reported from Ross's second voyage. Mr. Rowley informs us that it is said to be fairly common in this vicinity of northern Foxe Basin. It is a common, if not abundant, breeder in the many lakes and waters from Great Slave Lake to Baker Lake at the head of Chesterfield Inlet and northward to the main coast, but performs all its migrations westward to the Pacific, and is unknown on the Atlantic.

We may mention here another specimen of more than passing interest obtained by Mr. Rowley on a former trip to the high North—a Redpoll, *Acanthis linaria*, May 1937, Arctic Bay, northwestern Baffin Island. The specimen appears to be *A. l. rostrata* (Coues). No evidence of breeding accompanies the specimen but the date renders nesting possible if not probable. Redpolls are said to occur in Arctic Bay in winter, but it is not evident whether they are this or the closely allied *A. hornemanni* species.

He also informs us that a number of Snow Buntings, *Plectrophenax nivalis*, were reported to have attempted to winter (1938–39) in the neighborhood of Pond's Inlet, northern Baffin Island. They were heard in the dark many times about the post to well into winter but apparently did not survive until spring.—P. A. TAVERNER, *National Museum of Canada, Ottawa.*

RECENT LITERATURE

Hellmayr's 'Catalogue of Birds of the Americas'.[1]—The high standard and thoroughness that characterize Dr. Hellmayr's earlier volumes in this series are fully maintained in the present one which deals with the Neotropical Ploceidae (all introduced), Catamblyrhynchidae and Fringillidae; it concludes the American Passeriformes. The most difficult groups are finished and the end of the series, originally initiated by C. B. Cory in 1918, is in sight.

The statement in the introduction that "in a work of this magnitude it is simply impossible to investigate everything independently, and the author has to rely largely on the researches of others" arouses a chord of sympathy in the reviewer, but there is probably no ornithologist who is less dependent on the researches of others than Dr. Hellmayr; true, he has not gone into the species covered by the A. O. U. 'Check-list' as thoroughly as those not included, nor are his synonymies of the species dealt with by Ridgway in part 1 of Bulletin 50 of the U. S. National Museum as extensive, for the simple reason that lengthy duplication would result.

The classification of the Fringillidae is based on the arrangement proposed by the late P. P. Sushkin and recognizes five subfamilies: Richmondeninae, Geospizinae (confined to the Galapagos Archipelago and Cocos Island), Fringillinae (this subfamily has no normal American representative), Carduelinae and Emberizinae.

The only improvement that can be suggested here is that the work should have been brought up to as late a date as practicable before being submitted for publication, and then no further additions made of races newly described after that date. As a case in point, Griscom's review of the crossbills that appeared in 1937 is only mentioned in a footnote, while at least one name published in July 1938 appears in full at its proper place.

Among the nomenclatural changes proposed are the setting up of the genus *Periporphyrus* Reichenbach for *Caryothraustes erythromelas* (Gmelin); *Acanthis linaria* becomes *Acanthis flammea* on ground of page anteriority and *Fringilla pratensis* Vieillot replaces *Ammodramus australis* Maynard as the name of the Eastern Grasshopper Sparrow.—J. L. Peters.

Hyde's 'Life History of Henslow's Sparrow.'—This addition[2] to studies of one particular bird, now rapidly on the increase, is the product of three seasons' field work on breeding grounds in southern Michigan plus whatever could be gleaned from the examination of numerous specimens and the literature. A preliminary section on distribution and migration is naturally a compilation. The chief points of interest brought out are: (1) the possible enlargement of the former breeding range with the clearing of the colonial forests, and (2) a center of relative abundance in southern Michigan, Ontario and Ohio. For the benefit of local students there is a useful compilation of distributional data by States. The section on migration is

[1] Catalogue of Birds of the Americas | and the Adjacent Islands | in | Field Museum of Natural History | including all species and subspecies known to occur in North America, | Mexico, Central America, South America, the West Indies and | islands in the Caribbean Sea, the Galapagos Archipelago | and other islands which may be included on | account of the faunal affinities | by | Charles E. Hellmayr | Associate Curator of Birds | Part XI | Ploceidae—Catamblyrhynchidae—Fringillidae | vignette | Zoological Series | Field Museum of Natural History | Volume XIII, Part XI | December 31, 1938 | Publication 430 | pp. i–vi + 662.

[2] Hyde, A. Sidney. 'The Life History of Henslow's Sparrow, *Passerherbulus henslowi* (Audubon).' Miscell. Publ. Mus. Zool., Univ. Michigan, no. 41, 72 pp., 4 pls., 3 figs., 1 map, July, 1939. Price 75 cents.

pitifully thin. For most of it the author is not to blame—Henslow's Sparrow is practically unknown on migration—but the author did have an opportunity to determine the arrival of the first birds on the breeding grounds (given for only one year), when the full complement of breeding birds arrived, and to what degree females lagged behind the males. The two last points are not mentioned at all.

The chief contribution to knowledge which the author makes is in the relatively full sections dealing with the nest, eggs, and young. The female alone builds the nest, both sexes feed the nestlings, the incubation period is astonishingly brief, as is also the nest life of the young. It is not clear how the sexes were distinguished with certainty.

The author has done a good job in compilation, and what he could in three seasons' field work. Twenty years ago this monograph would have been wholly praised. Unfortunately, the technique of life-history studies and the criteria of adequacy are now enormously advanced. Perhaps the only point at which the author is really open to criticism is his selection of so supremely difficult a species. There is practically no discussion of terrritory, very little on courtship and mating, interesting hints only of possible promiscuity in a very loose social organization. It would be unreasonable to expect answers to all these questions in only three seasons' work in one place, with so secretive a little sparrow, that cannot be trapped and banded. Field experience over many years in every section of the breeding range can alone hope to explain the small total population, the basis for the selection of dry fields in one place, wet meadows in another; why a loose colonial breeding system should prevail in certain parts of the range, and should be unknown in others; where the scattered pairs, erratically enough, almost never return two years in succession to the same meadow. These are questions of outstanding interest about Henslow's Sparrow, which some day a life-history study will attempt to answer. In the meantime, however, the reviewer feels strongly that the author should be thanked for what he has been able to find out rather than blamed for gaps which at the moment cannot possibly be filled.—Ludlow Griscom.

'Proceedings' of the Eighth International Ornithological Congress[1] held at Oxford in 1934, forms an imposing volume containing an unusual number of papers of general interest. The introductory matter consists of the usual account of the activities, addresses and list of members. Then follow the papers presented at the congress (arranged in no obvious sequence)—some 67 in all with additional titles of those elsewhere published.

The papers cover a wide variety of subjects. First is a summary by Meise, of the progress in systematic study of birds since 1920, with lists of the new genera and species proposed. Others in systematic ornithology include an account of mutation in *Lybius* by Salomonsen, on the relation of the Struthiones to dinosaurs and to other birds by Lowe and Tucker, classification of the Anatidae by Delacour, problems in speciation in *Junco* by Miller, generic limits in the fruit pigeons by Peters, systematics of the Crested Guineafowl by Ghigi, taxonomic problems in the Bean Geese by Berry, and others. Under general biology, the White Stork comes in as usual for a share in three papers by Schüz, Bouet, and Schenk, respectively, European heronries are discussed in England and in Italy, Mrs. Nice expounds territory and mating in the Song Sparrow, and Middleton presents a summary of studies in the fluctuations of British game populations, with indications of well-marked cycles in several species.

[1] Proceedings | of the | Eighth International | Ornithological Congress | Oxford | July 1934 | Under the presidency of | Prof. Dr. E. Stresemann | — | Edited by F. C. R. Jourdain, M. A. 8vo, University Press, Oxford, x + 761 pp., 8 pls., text-figs., 1938.

Interesting conclusions as to the derivation of lipochromes of birds from plant carotenoids are given, and it is shown by Völker that lutein, a yellow vegetable pigment, is the source of the yellow lipochrome in birds. Professor Julian Huxley reviews the old subject of color and its meaning, with new conclusions and a classification of these, as for concealment, threat or advertisement, for sexual recognition and display, thus combining and sifting the views of Bates, Poulton, Hingston and Thayer. Sundry papers of a geographic nature, on birds of such widely separated areas as Asia Minor, South Africa and the Tres Marias Islands, alternate with others on homing and migration. A longer paper on the evidence offered by present distribution of birds in support of former land connections with Europe or northeastern Asia, by Stegmann, seems to have altogether ignored the now classic paper of Matthew on 'Climate and Evolution' (1915) wherein a reasonable explanation is offered. Finally bird protection, oil pollution, aviculture and feeding habits come in for consideration.

Although extending to over seven hundred pages, there is no index beyond a list of titles and no list of plates. The volume is handsomely printed and under the careful editorship of Rev. F. C. R. Jourdain, presents much evidence of painstaking preparation. It is therefore the more to be regretted that with singularly few exceptions, authors have neglected to give a summary paragraph at the end of their papers, setting forth the gist of their investigations. Few persons will have time enough at command to read through the volume with papers in three languages, so that such a help would have added greatly to the utility of the whole.—G. M. Allen.

Morgan's 'Field Book of Animals in Winter' is the latest addition to the well-known pocket guidebooks on natural history published by G. P. Putnam's Sons, and constitutes the twenty-second volume of the series, five of which have dealt with birds. It is written from the standpoint chiefly of a New England naturalist, in answer to the question, "What becomes of our animal life in winter?" For anyone who annually survives our varying winter season, comes to realize that it requires a degree of specialization and adaptation in habits and structure not found among the species of more equable regions. The opening chapters sketch the devices of northern animals for meeting the physical conditions of the cold months, and the activities of many animals at this period; and further considers the two general means of escape: migration, whether downward from the plants into the earth, from land to water, or to distant regions; and hibernation, whereby many types of both invertebrates and vertebrates pass the inclement period in inactivity. The matter of winter communities and the seasonal changes that go on in fresh water with consequent effect on the animal life are concisely and interestingly set forth. In fourteen chapters, the several main groups of freshwater and land invertebrates are taken up and their winter life briefly told, followed by five on the vertebrates. Birds come in for their proportionate share, with a chapter on winter bird life, ways of meeting winter, winter flocks, roosting aggregations, winter food, the conditions of water and shore. The chapter concludes with a series of short descriptions and characterizations of the winter birds commonly found in the northeastern States, following the same method as in many of the other chapters and there are four colored plates by Peterson illustrating over eighty species of winter birds. Other groups are well illustrated from photographs and drawings (including sundry older classic outlines); there is a helpful bibliography and a good index. Very few errors of type or of fact were noticed (p. 392, *Arquatella* is misspelled; p. 27, 'English Marmot' should be European Marmot, for this animal is not found in the British Isles). Because of its unique viewpoint, treating of animal life at a time when it is least obvious, this excellent

little book[1] should serve its purpose well and prove a useful and stimulating companion to the field naturalist in winter.—G. M. ALLEN.

Clements and Shelford's 'Bio-ecology.'—That animal life is dependent, directly or indirectly, on plant life is almost axiomatic; but that the two may be mutually interdependent to a greater or less degree, the one reacting either favorably or unfavorably on the other, has been less often emphasized. The present volume[2] essays to correlate the fields of plant ecology and animal ecology, and since the term 'ecology' is so often used of either alone, the term 'bio-ecology,' in spite of a seeming redundancy, was coined by Professor Clements to imply this synthetic aspect.

The opening chapter traces the historical development of this concept, particularly with relation to aquatic communities. The plant-animal formation (or 'biome') is the basic community unit and may be thought of as a complex organism. Its components have their several functions, life forms, aggregations, population densities and other features, which combine to give a general character to the whole. The influence of the community on the habitat, such as that exerted by burrowing animals or the roots of plants, the interrelations of the component organisms, their relations to food and shelter, aggregations and competition, are interestingly discussed. There is a valuable review of the subject of cycles which, it is emphasized, occur in plants as well as in animals, and seem likely to be determined by some common basic cause, concerning which the authors remark: "The evidence for a solar cycle in the weather of the globe and in related biological phenomena is now so strong that this must be regarded as by far the most probable primary cause involved."

The chapter on migration may be to the ornithologist one of the most interesting. Its discussion of the causes and methods of such movements is the best summary of the subject that the reviewer has read. That temperature and its physiological effects may be, as Dr. Kendeigh has suggested, one of the primal causes, is well brought out. For while recent investigations have shown that regular small increments of light may cause gonadal development in birds, this does not of necessity induce migration in spring, and the reverse process fails to account for the autumnal migration. That the origin of bird migration is to be sought in the geologically recent ice age, with its advance and retreat of ice caps, is satisfactorily disposed of by the later work of Clements, Chaney, and Berry, who find "the assumption that the climate during middle and late Tertiary was notably warmer and more equable and hence attended with little or no zonation far into the arctic regions is no longer tenable, as the revaluation of the classic fossil floras of North America has shown in particular."

As an illustration of the characteristic features of the 'biome' and the interdependence of its constituents and their relation to climate, there is an interesting chapter on the North American grassland area followed by chapters on freshwater and marine communities and an excellent bibliography of 36 pages. In the modern study of plant and animal relations ecologists seem to find a need for many new terms to express general concepts with greater precision. In the present work, many of these appear, some for the first time. While this may be necessary, it often makes difficult reading, where one must keep a finger in a glossary. Ornithologists seldom find

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[1] Morgan, Ann Haven. Field Book of Animals in Winter. 16mo, xv + 527 pp., 283 illustrations including 4 colored plates, 1939; G. P. Putnam's Sons, New York City. Price $3.50.

[2] Clements, Frederic E., and Shelford, Victor E. Bio-ecology. 8vo, vii + 425 pp., illustr., 1939; John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price $4.50.

ambiguity in writing of migration or of a migrant individual, without recourse to the suggested terms 'ecesis' and 'migrule,' to express these ideas. Sometimes one has an impression that ecology is in danger of being overburdened with such technical terms.

This volume is a very welcome survey of the general field of interrelationships of combined animal and plant communities, which should prove valuable not only as a manual for the teacher and student of biology in its original sense, but also as a stimulus to the investigation of a still fertile field.—G. M. ALLEN.

Mrs. Bailey's 'Among the Birds in the Grand Canyon Country'[1] is in effect a convenient 'satchel guide' depicting the general features of bird life that the usual tourist may expect to see, besides much more that the casual observer will miss or may find only on a more extended stay. Only by living in it, camping in it, and repeatedly visiting it at different times and seasons, as the author has done, may one form a real acquaintance with this extraordinary region and its animal life. In twenty brief chapters Mrs. Bailey takes the reader from the top of the South Rim down by easy stages from zone to zone till he reaches the very bottom of the vast abyss. Thence after explorations and digressions, he continues across and up to the Kaibab Plateau on the farther side. The familiar or characteristic birds and mammals along the way are charmingly written of, so the reader easily imagines that he himself is making the transit. The final chapter is by Vernon Bailey on the remoter corners of the canyon bottom. The pages are profusely illustrated with half-tone cuts of the scenery, the many birds, the deer and squirrels, some of them reproduced from photographs, others from drawings from various sources, many from the author's 'Handbook of Western Birds.' Finally there is an illustrated field key to the males of the commoner birds the visitor is likely to meet with, followed by a nominal list of 188 birds hitherto recorded from the region, and an index.

Written in easy descriptive language with abundant illustration, accurate and informative, it is the sort of booklet that will appeal to the increasing numbers of our citizens who are learning the educational and recreational value of the national parks where wildlife may be enjoyed undisturbed.—G. M. ALLEN.

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[1] Bailey, Florence Merriam. Among the Birds | in the | Grand Canyon Country. U. S. Dept. of the Interior, National Park Service; 8vo, xiii + 211 pp., illustr. Price 30 cents, Superintendent of Documents, Washington, D. C.

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CONSERVATION NOTES

EDITED BY FRANCIS H. ALLEN

THE movement for bird protection initiated by the American Ornithologists' Union in 1884–85 has widened its scope of recent years and is now integrated with the larger movement for the conservation of all our replaceable natural resources. We now realize that the welfare of our wild birds depends most of all on food and cover, and that these in turn depend on soil and water. This is the line taken by the National Wildlife Federation under the leadership of the dynamic 'Ding' Darling and his able and energetic successor, David A. Aylward. Regarding the education of the rising generation in conservation principles and practice as of prime importance, the Directors of the Federation have been studying the approach to a practical program. A good beginning is indicated in the report of a 'Conference on Education in Conservation' held in Detroit last February.

THE Massachusetts branch of the Wildlife Federation was organized under the leadership of the late John C. Phillips as a Massachusetts Conservation Council composed of delegates of fifteen State-wide organizations. The Council, usurping the functions of none of the member organizations, unites all of them where united action is desirable. One of its chief activities this year has been equipping a 'Conservation Van' and sending it out on a missionary tour of the State in the charge of two well-trained young men who preached conservation in all its branches to Boy and Girl Scouts and other groups in camps, on fair-grounds, and elsewhere.

THE latest reports of the wildfowl situation give hope for the future. We must watch the results of the extension of the open season this year. The outlook for the preservation of the endangered species of our birds seems to be encouraging in the main. The National Association of Audubon Societies reports a new colony of Roseate Spoonbills in Florida and an estimated total population for the State of about three hundred birds, while in Texas the nests of this species actually counted numbered 794—a climb from zero in less than twenty years. There was also a very satisfactory increase of Reddish Egrets in Texas, nearly a thousand more having been brought to light by the discovery of three new colonies this year. And the Biological Survey announces that there are now at least 199 Trumpeter Swans in the United States—an increase of 51 since August of last year.

GREAT efforts are being made by the Biological Survey, the National Association of Audubon Societies, and other agencies to save the California Condor and the Ivory-billed Woodpecker, and we can still hope for their success. Hopes for the resurrection of the Carolina Paroquet seem to have been premature, but continued sporadic reports of the Eskimo Curlew fan the dying hopes for that perhaps extinct species. Perhaps the visit of Dr. T. Gilbert Pearson to South America this fall may have a good effect on the fortunes of other rare shorebirds if not on this one.

THE Pittman-Robertson Act, one of the most important achievements of the National Wildlife Federation, provided this year for the distribution of $1,380,000 among the States. The apportionment is based partly on area and partly on the number of hunting licenses issued and is contingent on the appropriation by the State of an amount equal to at least one third of the Federal allocation.

FROM the beginning of the fiscal year, July 1, the Biological Survey has operated as a bureau of the Department of the Interior after many years in the Department of Agriculture. This transfer was effected by the reorganization act passed by Congress early in the year. The organization and personnel of the bureau remain unchanged.

DISCUSSION

Unorthodox Thoughts on Migration

We refer constantly to migration paths or routes but since birds inhabit almost the entire land surface, there must be migration everywhere. This is evident not only as a logical deduction but also in practical experience. One may travel widely and stop at random, yet in season he will not fail to hear, wherever he may be, the calls of nocturnal migrants, from the sonorous honks of geese to the peeps, chirps, and squeaks of a variety of lesser voyagers. To say the least, migration must, in general, be on very broad fronts. The concentrations that suggest migration-highway terminology probably are mostly due to the configuration of land and water and apart from that modifying influence, migration must be very diffuse.

The calls of migrants heard throughout the hours of darkness, but ceasing with the dawn, pose another question. It is tacitly assumed, I believe, that when we no longer hear the birds, it is because they have alighted. This, however, is manifestly not true of the geese, and may not be of others. They may keep on going at the same height silently, or at greater elevation, out of hearing. If the stopover hypothesis were correct, on a morning after hearing migrants in apparent swarms, we should expect to find the countryside alive with birds, but how rarely do we have that experience. Referring especially to the vicinity of Washington, D. C., where I have made most of my observations for years, one may hear birds passing over in large numbers practically every night in September, yet birds in the landscape are in that month at the lowest ebb of the year.

There is at present considerable reaction against the teachings of the subspecies cult, which seems commendable, but it should not be forgotten that speculation and observation should always be kept in touch. There is evidence that some birds do not return to the area where they were reared, that apparent representatives of one subspecies sometimes breed in the territory of another race, and that wanderers, as the crossbills, have subspecies without definite breeding ranges. These are hard facts, for if birds do not return at least approximately to the area of their nativity, geographic races cannot have been developed, as now conceived, by an age-long process of environmental molding or selection. If subspecies are real and if the movement to the breeding grounds is to a considerable extent dispersive, then direct environmental influence producing its effect on the growing birds within a few weeks must be postulated as the cause of their characteristics. This is a difficult assumption; moreover there is evidence, at least for mammals, that subspecies are of genetic import. The whole question needs re-examination in the light of all available knowledge of which that relating to migratory birds, even if fragmentary, is not of least importance.

The human mind is prone to query 'Why'? but usually is not critical enough of its answers to that question. Postulated causes of migration are as numerous as alleged remedies for an incurable disease and scarcely more impressive. Probably numerous factors are involved but in divining them it should not be forgotten that most migrational phenomena are of very ancient origin. To ascertain their cause in any direct way is, therefore, impossible. In time each cause may have been modified so as to be no longer traceable. As is the case with most scientific speculation, we find in the realm of migrational phenomena that what appears satisfactory in one case must be rejected in another. A reason acceptable for southward, cannot apply to northward, migration; the urge for a bird starting to move in the middle of summer

cannot be the same as for one that waits until frost; the motivation of a species that goes to the Antarctic hardly coincides with that of one that seeks the tropics; and so on. One comparatively recent treatise on the subject was given the very descriptive title: 'The Riddle of Migration,' and that book as well as other works on migration have left cause still a riddle.—W. L. McAtee.

ANNOUNCEMENTS

The 'Field Museum News' announces that the museum has recently acquired the private collection of Dr. Louis B. Bishop. This collection comprises some 50,000 birdskins, including specimens of nearly all forms of birds occurring north of Mexico. Among these are thirty type specimens, and several species of birds now extinct, such as Carolina Parakeet, Guadalupe Flicker, Eskimo Curlew, and Passenger Pigeon. Part of the collection had been stored in New Haven, Connecticut, but a further part will remain in Los Angeles where Dr. Bishop will continue during the rest of his life to carry on research upon it.

The collection of the late Amos W. Butler, consisting of about 3,300 skins, has been acquired by Purdue University.

From the Carnegie Museum at Pittsburgh, comes word that the long-projected work on 'The Birds of Western Pennsylvania,' by W. E. Clyde Todd, is at last in press. Its publication is being sponsored by the Buhl Foundation of Pittsburgh. It will be in one volume of nearly 700 pages and will be illustrated by 22 plates in color, depicting 118 species, by Dr. George Miksch Sutton. Its appearance some time in the early part of the year will be awaited with interest.

In order that members may keep in touch with important matters regarding bird protection and conservation, Mr. Francis H. Allen has consented to contribute a page of news items to the issues of 'The Auk,' beginning with the current number.

OBITUARIES

FRANKLIN BENNER was an original member of the American Ornithologists' Union. He was elected to Associate Membership in 1883 with a group of 19 Active and 40 Associate Members admitted the year following the founding of the Union. He was at that time thirty years of age and had been actively interested in birds since early boyhood. The record seems to show that his membership terminated between 1895 and 1901.

Franklin Benner was born at Astoria, Long Island, New York, on November 13, 1853, and died at Minneapolis, Minnesota, on April 13, 1938. He was the son of Robert and Mary Van Antwerp Benner. After attending the Anthony Grammar School, New York City, he entered Phillips Academy, Andover, Massachusetts, and was graduated in 1872. He was a special student at Yale University 1872–73. The summer of 1873 was spent with the U. S. Fish Commission on the Maine coast. He visited Minneapolis, Minnesota, in the summer of 1874 and in 1879 returned to that city where he lived until his death. On June 18, 1884, he married Miss Katherine Skiles of Minneapolis. They had three daughters, Mary, Dorothy, and Katherine, who with his wife survive him.

An interesting chapter in the early New York life of Benner is that he with Ernest Ingersoll issued the call that resulted in the formation of the present New York Linnaean Society. A book containing, in Benner's handwriting, the original constitution and by-laws of the society and a transcript (?) of the minutes of the first year is in the possession of Benner's daughter Dorothy. This book has been loaned to the writer for use in this connection and it may be of historical interest to quote the minutes of the first meeting.

"Pursuant to a call signed by Franklin Benner and Ernest Ingersoll several gentlemen, residents of New York City and vicinity, gathered at the office of Robert Benner, Esquire, No. 55 Liberty Street, New York City, on March 7, 1878, at 7.30 p. m. to take steps toward the formation of a local society of natural history. The names of those present were as follows: H. B. Bailey of New York City, Franklin Benner of Astoria, L. I., E. P. Bicknell of Riverdale, N. Y., John Burroughs of Esopus-on-Hudson, N. Y., Harold Herrick of Orange, N. J., F. H. Hoadly of New York City, Ernest Ingersoll of Jersey City, N. J., Newbold T. Lawrence of New York City, C. Hart Merriam of New York and Wm. C. Osborne of New York. F. Benner was made chairman and the assembly proceeded to the election of permanent officers, the ballots resulting in the choice of C. Hart Merriam, President, Harold Herrick, Vice President, Ernest Ingersoll, Recording Secretary, and H. B. Bailey, Corresponding Secretary and Treasurer.

"Messrs. Bailey, Ingersoll and Lawrence were appointed a committee by the president to draft a consitution and by-laws for the government of the society, which after full discussion was decided to be called 'The Linnaean Society of New York City'."

After March 23, 1878, the meetings were held at the residence of Mr. N. T. Lawrence, 45 East 29th Street. On November 2, 1878, Mr. Ingersoll resigned as secretary and Mr. Benner was elected in his place. The minutes as here-recorded for 1878 and early 1879 contain the names of most of the men prominent in ornithology at that time and since, and there is much in regard to the discussions that took place at the meetings. Portions of these records are especially interesting as revealing the experiences and early views of leading ornithologists of that day. John Burroughs was

elected a Corresponding Member on March 16, 1878, George N. Lawrence an Honorary Member April 13, 1878, and Theodore Roosevelt a Corresponding Member January 11, 1879. T. R.'s address was given as 16 Winthrop Place, Boston.

When Benner visited Minneapolis in the summer of 1874, he devoted the time to collecting birds, birds' eggs and plants. The writer of this article, then a lad of sixteen, had been experimenting in making birdskins with poor success. Hearing of the presence of a visitor in the city collecting birds, he sought him out and found Benner busily at work at a bench in a carriage house. A cordial reception was followed by a demonstration of the technique of making up birdskins. Benner was an expert and rapid workman and willingly imparted his knowledge to an interested boy. Benner was also a good field man and much of the time that summer was spent in his company exploring the woods and waters about what was then little more than an expanding village. Then and there began a close friendship which lasted until Benner's death. The material taken that summer and all the rest of Benner's collection of birds and eggs were later donated by him to the University of Minnesota and may now be found in the study collections of the Museum of Natural History.

On Benner's return to Minneapolis in 1879, he and the writer made a collecting trip to the extreme western prairie part of Minnesota and were rewarded with a number of interesting discoveries that added materially to the ornithology of the State. An article (under joint authorship but largely prepared by Benner) descriptive of the results of the trip was published in the 'Bulletin' of the Nuttall Ornithological Club for January 1880. Benner published several other articles on birds in 'Forest and Stream,' 'The Country,' and the 'Bulletin' of the Minnesota Academy of Sciences (for 1887–89). In early life he cherished a desire to write and in several non-scientific articles that he prepared he showed facility in both composition and expression but after becoming engrossed in business this interest waned and during the latter half of his life, though he maintained a reminiscent interest in ornithology and literary matters, he never engaged in any work along such lines. This was unfortunate for he had a keen, well-informed mind, had a knowledge of several modern languages, and he might have gone far had he not allowed a rather varied business career entirely to submerge all else.—Thos. S. Roberts.

Ferdinand Schuyler Mathews, an Associate of the American Ornithologists' Union since 1917, died in Plymouth, New Hampshire, August 20, 1938, at the age of eighty-four. He was born in New Brighton, on Staten Island, New York, May 30, 1854, graduated from Cooper Institute in 1873, and later in Italy in 1887. During the decade from 1880 to 1890 he was associated with L. Prang & Co. of Boston and later with the Gray Herbarium of Harvard University.

While with Prang & Co. he prepared and illustrated a series of popular books on flowers and trees which were published by D. Appleton & Co. Among his best known publications were 'Familiar Flowers of Field and Garden,' 'Field Book of American Wild Flowers,' both of which were issued in several editions, and 'Familiar Trees and their Leaves,' 1901 and 1911. In 1904 appeared his principal ornithological work 'Familiar Birds and their Songs' and in 1921 'The Book of Birds for Young People.' His chief interest in ornithology seems to have been popular bird study. Bird songs particularly attracted him and he is generally known as an authority on bird music.

By his work as an artist and author Mathews gained a place in the small group of writers who did so much to foster popular interest in nature study forty years ago when that subject was beginning to attract attention.—T. S. Palmer.

EDMUND PLATT, an Associate of the American Ornithologists' Union since 1917, died of heart disease, August 27, 1939, at Chazy, New York. Born in Poughkeepsie, New York, February 2, 1865, the son of John I. and Sarah Frances (Sherwood) Platt, he was well along in his seventy-fifth year at the time of his death.

After graduating from Harvard University in the class of 1888 and from the Eastman Business College of Poughkeepsie, he taught history and English for two years at the Riverview Military Academy, New York, and then spent a year in Superior, Wisconsin, as editorial writer on the 'Evening Telegram.' Upon his return to Poughkeepsie he entered upon a forty-year association with the 'Poughkeepsie Eagle' and in 1892 married Miss Adele Innes. At the election in 1912 he was chosen as the Representative of the 26th New York District. Entering Congress on March 4, 1913, the day the Migratory Bird Law was approved, he served during the seven eventful years which included the contest over the enforcement of the Migratory Bird Law and the enactment of the Migratory Bird Treaty Act. Before his retirement from Congress he had become chairman of the important Banking Committee and, through his knowledge of birds and conservation, the spokesman on the floor of the House on all measures dealing with conservation of wildlife. During the consideration of the Agricultural Appropriation Bill in the House on April 13, 1916, he delivered a notable speech on the migration of birds and the work of the Biological Survey in protecting game reservations. On June 7, 1920, he resigned to accept an appointment on the Federal Reserve Board, served as Vice-governor of the Board for ten years and then retired to become Vice-president of the Marine Midland Corporation.

During his residence in Washington he maintained an active interest in bird work both in and out of Congress. He possessed a good practical knowledge of birds in the field, was an enthusiastic and accurate observer and particularly interested in the migration of shorebirds and waterfowl. He took an important part in the work of the local Audubon Society, served as its Vice-president and assisted actively in its field work.

Most of Mr. Platt's writings naturally were on subjects dealing with legislation and finance and he seems to have published little or nothing on birds over his own name but freely contributed his observations to others. Earnest, quiet and affable, a true gentleman in every sense of the word, Edmund Platt made friends readily and wielded considerable influence in the circles in which he moved. His interest in birds served not only as a diversion from the ordinary routine of daily life but furnished an outstanding example of the important contributions to ornithology which may be made by a man even when engrossed in the duties incident to an active business career.—T. S. PALMER.

REYNOLD JOCELYN ONSLOW BRAY was born October 5, 1911, at Ockham, near Ripley, Surrey, England. He was educated at Harrow (1925–30), Balliol College, Oxford University (1930–32), and at Wye Agricultural College (1932). He was married in March 1934, to Gillian Margaret Warren Butler. A daughter was born to them on August 10, 1938. Notice was cabled to Bray at Churchill where he was waiting to embark upon what proved to be his last expedition. At his request the child was named Handa, after a bird island off the northwest coast of Scotland that he and Mrs. Bray had visited the previous May.

Bray was on the Oxford University Exploration Club's expedition to Akpatok Island in Ungava Bay, Hudson Strait, in 1931. This expedition, on which Bray was nominally photographer, made a complete survey of this little-known island. The

story was told in 'The Isle of Auks,' by N. Polunin, 1932. In 1932–33, Bray, with T. H. Manning, made a winter tramp through Swedish, Finnish, and Russian Lapland, from Bodo to Murmansk. He wrote up this fascinating journey, which included trouble on the Soviet frontier, in 'Five Watersheds,' published in January 1935. He then studied Russian and took the War Office interpreters' course at London University, and visited Russia from June to October 1935. Again with Manning, he took part as an ornithologist in the British Canadian Arctic Expedition, March 1936–October 1937, to Southampton Island and Melville Peninsula. Much of the eastern shores of those lands was mapped as well as the unknown coast of Baffin Island on the east of Foxe Basin.

In 1938, Bray planned with P. D. Baird to go to Igloolik in northern Foxe Basin for a two-years' stay, expecting to travel as far as Pond's Inlet and to work out a key locality important in arctic ornithology. Due to bad ice conditions, the R. C. missionary supply ship 'Teresa,' upon which they embarked at Churchill, was unable to get through to Foxe Basin, so Bray and Baird left the vessel at Winter Island off the east coast of Melville Peninsula to make their way three hundred miles north in a whale-boat. On September 14, the thirteenth day of their boat journey and when they were within forty miles of Igloolik, engine trouble and heavy seas decided them to land. Baird was on shore when the anchor apparently dragged, and Bray could not make any progress by poling. He then tried to bring a line ashore in a folding canvas boat and was blown out to sea. Baird made every effort to save him by sailing the whale-boat but to no avail. The frail craft with Bray in it was soon lost to sight. A cairn was erected including a soapstone slab on which legends in English and Eskimo were carved. The Eskimo part reads: "Um li gar juk died here. Let us not forget him."

The taste for arctic exploration, like a strong fever, seems regrettably often to end only in death. Long is the roll of those who have perished exploring the most inhospitable of earth's climes and not least among them was Bray. Quiet, almost reticent, he could at need speak or write most clearly and effectively. For his years he was indeed broadly experienced and deeply educated. He had a fine sense of humor and a sound all around humanity.—W. L. McAtee.

THE FIFTY-SEVENTH STATED MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION

BY LAWRENCE E. HICKS

THE third California meeting was held June 19–24, 1939, at Berkeley and San Francisco. Headquarters were at the Hotel Durant in Berkeley and most of the business sessions were held there. The public sessions were held in the Life Sciences Building, Museum of Vertebrate Zoology, of the University of California, on Tuesday and Wednesday, and in the Simpson African Hall of the California Academy of Sciences in San Francisco on Thursday.

Business sessions.—The meetings on Monday, June 19, included two sessions of the Council, a meeting of the Fellows at 4 p. m. and a meeting of the Fellows and Members at 8 p. m. The evening business session was attended by 12 Fellows and 17 Members.

There were elected two Fellows, one Honorary Fellow, two Corresponding Fellows, seven Members and 499 Associates. On November 1, 1939, vacancies in the various membership classes were as follows: Fellows, 2; Honorary Fellows, 2; Corresponding Fellows, 13; Members, 23.

The Treasurer's preliminary report was accepted and the meeting authorized the Finance Committee (acting without the Treasurer) to review and approve the final audited report which would be available at the end of the current fiscal year (September 30). This final report (approved October 25, 1939) appears farther on. The Treasurer stated that corresponding expenses were 25% lower than during the previous year, and that various economy and efficiency measures promised eventually to give the A. O. U. a balanced budget. The Trustees' Report showed that the endowment funds were in good condition.

The Secretary's report indicated that on June 1, 1939, the paid-up members of the Union were as follows: Associates, 1,323; Members, 113; Fellows, 47; Associates-elect, 54,—total 1,537. In addition there were 167 subscribers and 164 delinquent members of all classes. Fourteen resignations had been accepted during the year. Roll-call was held for the 22 members deceased since the last meeting: 4 Fellows, 1 Fellow Emeritus, 2 Honorary Fellows, 2 Members and 13 Associates.

Dr. Herbert Friedmann retired after a two-year term as President and was replaced by Dr. James P. Chapin. The vacancy thus created in the Vice-presidency was filled by the election of George Willett. The retiring members of the Council (Dr. Arthur A. Allen, Dr. Wilfred H. Osgood, and Dr. J. Van Tyne) were replaced for three-year terms by P. A. Taverner,

Ludlow Griscom and Dr. Alden H. Miller. All of the other officers were re-elected.

Two new amendments to the by-laws, first proposed at the 1938 meeting, were passed. These increase the maximum limit for the number of Members from 125 to 150 and make the Editor a member of the Council. The report of the Committee on Cooperation (James L. Peters, Herbert L. Stoddard, Rudyerd Boulton, Alden H. Miller and W. L. McAtee) was accepted. Several new amendments to the by-laws were tentatively approved and laid upon the table for final action in 1940. These included proposals to: (1) grant affiliated ornithological societies meeting specific qualifications a voting representative on the A. O. U. Council, (2) appoint a nominating committee of three Fellows on staggered terms to supplement the present methods of nominating Fellows, Members, Honorary Fellows and Corresponding Fellows; (3) make dues of all members $4.00 per year (except present dues of Fellows would continue until 1950); (4) make the cost of all new life memberships $100 regardless of membership classification.

The Council voted to limit each edition of 'The Auk' to 300 copies in excess of current needs; to use no color plates in 'The Auk' in 1940 unless contributed; to distribute for educational purposes back copies of 'The Auk' in excess of 250 copies; to authorize, if found feasible, up to 30 pages of advertising in each volume of 'The Auk'; and to announce that claims for replacement of missing or defective copies will not be honored unless received by the Business Manager within six months of publication of the particular number involved.

The matter of consolidation of the six A. O. U. endowment funds into a single fund was referred for joint consideration and decision to the Finance Committee, Endowment Committee and the Investing Trustees.

The 1939 award of the Brewster Medal was made posthumously to Dr. Witmer Stone in recognition of his two-volume work on 'The Birds of Old Cape May.' Dr. Friedmann, as general chairman, summarized the reports of the various sub-committees of the A. O. U. Research Committee. The present Trustees (George Stuart III, C. H. Riker and Edward Norris) were re-elected, as was George Willett as editor of the Ten-year Index of 'The Auk.'

The Union voted to accept the report of the Committee on Bird Protection (Victor Cahalane, William Finley, Clarence Cottam and Aldo Leopold). The full report will appear in a later issue of 'The Auk'.

A report was read which had been prepared by Dr. Alexander Wetmore as Chairman of the Committee on Classification and Nomenclature of North American Birds. Dr. Alden H. Miller and Dr. W. L. McAtee read a series of prepared statements compiled from various contributors. These statements collectively constituted a guide for procedures to be used by the

Committee in its work on the next A. O. U. 'Check-list of North American Birds.' The Union voted to accept these recommendations and directed that they be transmitted to the Committee for consideration.

The Union adopted the report of the Resolutions Committee (A. M. Bailey, A. A. Allen and Ludlow Griscom). This expressed appreciation to the following for their contribution to the 1939 meeting: the Local Committee, the officers of the Union, the Ladies' Entertainment Committee, the officials of the University of California, the Museum of Vertebrate Zoology and the California Academy of Sciences, and those cooperating on the field trips to Muir Woods, Point Reyes, the Berkeley Hills, Point Lobos Preserve and the Hastings Research Area.

Public Meetings.—The public meetings opened on Tuesday morning with an address of welcome by Robert C. Miller, Director of the California Academy of Sciences, and a response by President Herbert Friedmann. The program included thirty papers, three of which were read by title, and as usual covered a wide range of subjects, both popular and technical. The Tuesday afternoon session was a symposium on the subject, 'Territorial Behavior in Birds.' Dr. Alden H. Miller introduced papers on this subject by Mary Erickson, Herbert Friedmann, and David H. Lack of England. Classified as to content the papers covered the following subjects: life history and food habits, 9; behavior, 7; taxonomic, 5; faunal, 5; conservation or education, 5; exploration, 3; anatomy and physiology, 3; waterfowl, 2; biography, 2; distribution and migration, 2; bird-banding, 1; general or miscellaneous, 1.

Social Events.—On Tuesday evening 185 persons attended a buffet supper at an open house at the Museum of Vertebrate Zoology. This event afforded a welcome opportunity for visits with friends while reviewing the superb vertebrate collections. Wednesday evening was occupied by the annual dinner at the International House, with 195 present. The highlight of the evening was the first showing of a color film by J. R. Pemberton on 'The California Condor—a four-year record of its life and manners.' Wednesday noon a group photograph was taken of the 95 members present at that time.

Excursions.—Friday, June 23, 107 persons participated in an all-day field trip to scenic areas in Marin County—Muir Woods with its redwood canyon, and Point Reyes with its thousands of nesting seabirds, aquatic mammals of several species and a precipitous slope covered with the finest natural 'rock garden' we ever hope to observe. On Saturday, June 24, a party visited bird haunts in the Berkeley Hills. Another party of 36 journeyed to the Point Lobos Preserve to see thousands of seabirds, several hundred sea lions and a group of no less than 16 of the rare sea otters. Most of this party spent Saturday night at the beautifully located Asilomar

Hotel along the California Coast, from which a most spectacular phosphorescent surf could be observed throughout the night.

Sunday morning most of the group toured the Hastings Preserve which is utilized as an area for research on population problems by workers from the University of California. Collectively the various field trips arranged probably exceeded those available at any previous American Ornithologists' Union meeting in both scenic interest and the unbelievable wealth of bird life which could be observed.

THE PROGRAM

Papers are arranged in the order in which they were presented at the meeting. Starred papers were illustrated by lantern slides; those with a double star were illustrated by motion pictures.

TUESDAY MORNING

Welcome by ROBERT C. MILLER, Director of the California Academy of Sciences.

Response by HERBERT FRIEDMANN, President, American Ornithologists' Union.

Roll call of Fellows and Members, Report of the Business Meeting, Announcement of the Result of Elections.

Report of the Local Committee on Arrangements. ALDEN H. MILLER, Museum of Vertebrate Zoology, *Chairman*.

1. A Perspective of Ornithology. TRACY I. STORER, University of California, Davis, California.
2. Aspects of Feather Pigmentation in the Flickers. FREDERICK H. TEST, Museum of Vertebrate Zoology, Berkeley, California.
3. A Pleistocene Cavern Fauna from Nuevo Leon, Mexico. LOYE H. MILLER, University of California at Los Angeles, California.
4. *Remarks on the Avian Zoogeography of Yucatan. J. VAN TYNE and MILTON B. TRAUTMAN, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.
5. In Memoriam: Samuel Prentiss Baldwin. S. CHARLES KENDEIGH, Experimental Zoology Laboratory, Champaign, Illinois. (Read by title.)
6. In Memoriam: John Charles Phillips. GLOVER M. ALLEN, Museum of Comparative Zoology, Cambridge, Massachusetts. (Read by title.)

TUESDAY AFTERNOON

Symposium: Territorial Behavior in Birds.

7. Introduction: Extreme Manifestations of Territorial Behavior. ALDEN H. MILLER, Museum of Vertebrate Zoology, Berkeley, California.
8. Territory in Permanently Resident Species. MARY ERICKSON, Museum of Vertebrate Zoology, Berkeley, California.
9. Territory in Social Parasites. HERBERT FRIEDMANN, U. S. National Museum, Washington, D. C.
10. **An Analysis of Aggressive Behavior. DAVID H. LACK, London, England.

Discussion of Symposium Papers.

WEDNESDAY MORNING

11. A Taxonomic Review of the Blue Jay (*Cyanocitta cristata*). JOHN R. ARNOLD, Stockton Junior College, Stockton, California.

12. Fall Wanderings of Clapper Rails. ROBERT T. ORR, California Academy of Sciences, San Francisco, California.
13. *Observations on the Singing Postures of a Few Birds. DAVID G. NICHOLS, Berkeley, California.
14. *Parallel Adaptations of Trunk-foraging Birds. FRANK RICHARDSON, Museum of Vertebrate Zoology, Berkeley, California.
15. *Light Intensities Determining the Time of Morning Awakening and Cessation of Evening Song. ROBERT C. MILLER, California Academy of Sciences, San Francisco, California.
16. *The Occurrence of Vestigial Claws on the Wings of Birds. HARVEY I. FISHER, Museum of Vertebrate Zoology, Berkeley, California.

WEDNESDAY AFTERNOON

17. *The Wildlife Refuge Program of the Biological Survey. IRA N. GABRIELSON, United States Biological Survey, Washington, D. C.
18. Birds of the Sacramento Migratory Waterfowl Refuge. PETER J. VAN HUIZEN, Sacramento Migratory Waterfowl Refuge, Willows, California.
19. History of a Family of Black Phoebes. GEORGE OBERLANDER, San Francisco, California.
20. **Habits of White-tailed Kites and their Preservation. ROBERT T. MOORE, California Institute of Technology, Pasadena, California.
21. **Nesting Activities of White-tailed Kites. ARTHUR BARR, Pasadena, California.

THURSDAY MORNING

22. *Sex and Age Composition of California Quail Populations. JOHN T. EMLEN, JR., University of California, Davis, California.
23. *The Birds of Some North Pacific Refuge Islands. STANLEY G. JEWETT, United States Biological Survey, Portland, Oregon.
24. **The Life History of the Golden Eagle. JAMES B. DIXON, Escondido, California.

THURSDAY AFTERNOON

25. **An Arizona Nest of the Coppery-tailed Trogon. ARTHUR A. ALLEN, Cornell University, Ithaca, New York.
26. *The Dispersal of 40,000 Banded Starlings. LAWRENCE E. HICKS, Ohio Wildlife Research Unit, Ohio State University, Columbus, Ohio.
27. Affinities of the Tetraonidae as indicated by Courtship Behavior. JAMES MOFFITT, California Academy of Sciences, San Francisco, California.
28. **Beautiful Birds of the Southern Audubon Sanctuaries. JOHN H. BAKER, National Association of Audubon Societies, New York City.
29. **Colorado Birds in Color. ALFRED M. BAILEY, The Colorado Museum of Natural History, Denver, Colorado.

ATTENDANCE

The third California meeting had a registered attendance of 95 members (all classes) and 120 visitors—a total of 215. The list of those present in 1939 included 16 Fellows, 1 Corresponding Fellow, 18 Members and 60 Associates. This attendance far exceeded that of the second California

meeting of 1915. The number of visitors registered, save for the 1935 Toronto meeting, was the largest on record.

Members were present from twenty-four States and Provinces. Visitors coming from a distance added to this geographical representation. Forty-five members and 17 visitors registered from localities outside of California. Exclusive of visitors the eight largest delegations were: California, 50; Canada, 6; Washington, D. C., 6; New York, 6; Arizona, 3; Illinois, 3; Ohio, 3; Oregon, 3. The three members traveling the greatest distances were: Ronald W. Smith, Wolfville, Nova Scotia; William H. Phelps, Caracas, Venezuela; and David Lack, London, England.

ARIZONA, 3—*Member*, Harold C. Bryant, Grand Canyon. *Associates*, Gale Monson, Warren; Allan R. Phillips, Tucson.

BRITISH COLUMBIA, 3—*Member*, J. A. Munro, Okanagan Landing. *Associates*, Francis Kermode, Victoria; Theed Pearse, Courtenay.

CALIFORNIA, 50—*Fellows*, Louis B. Bishop, Pasadena; Joseph Mailliard, San Francisco; Alden H. Miller, Berkeley; Loye H. Miller and George Willett, Los Angeles. *Members*, Clinton G. Abbott, San Diego; W. Lee Chambers, Eagle Rock; Joseph S. Dixon, Berkeley; Hildegarde Howard, Los Angeles; Laurence M. Huey, San Diego; Jean M. Linsdale, Monterey; James Moffitt, San Francisco; Robert T. Moore, Pasadena; Tracy I. Storer, Davis; E. Lowell Sumner, Jr., San Francisco. *Associates*, Amelia S. Allen, Berkeley; John R. Arnold, Stockton; Arthur Barr, Pasadena; Seth B. Benson, Berkeley; Mrs. A. P. Bigelow, Oakland; Eliot Blackwelder, Stanford University; George G. Cantwell, Los Angeles; John E. Cushing, Jr., San Francisco; John M. Davis, Eureka; Ralph Ellis, Berkeley; John T. Emlen, Jr., Davis; E. Raymond Hall, Berkeley; Walter E. Howard, Davis; A. Sidney Hyde, San Francisco; Mrs. George E. Kelly, Alameda; Eric C. Kinsey, Manor; E. Whitney Martin, Palo Alto; Herbert N. McCoy, Los Angeles; Robert T. Orr, San Francisco; John R. Pemberton, Altadena; Gayle B. Pickwell, San Jose; Sidney D. Platford, Los Angeles; William E. Ritter, Berkeley; Howard Robertson, Los Angeles; John McB. Robertson, Buena Park; W. T. Shaw, Fresno; O. P. Silliman, Salinas; E. L. Sumner, Sr., Manlo Park; Lewis W. Taylor, Berkeley; Peter J. Van Huizen, Willows; Laidlaw O. Williams, Carmel; Robert S. Woods, Azusa; Margaret W. Wythe, Berkeley.

COLORADO, 1—*Member*, Alfred M. Bailey, Denver.

CONNECTICUT, 1—*Associate*, Leonard Wing, New Haven.

IDAHO, 1—*Associate*, William H. Marshall, Boise.

ILLINOIS, 3—*Members*, Rudyerd Boulton, Chicago; H. B. Conover, Chicago. *Associate*, Mrs. Herman D. Smith, Lake Forest.

IOWA, 1—*Member*, T. C. Stephens, Sioux City.

KANSAS, 1—*Associate*, Harry L. Rhodes, Topeka.

LOUISIANA, 1—*Associate*, George H. Lowery, Jr., Baton Rouge.

MASSACHUSETTS, 2—*Fellow*, Ludlow Griscom, Cambridge. *Associate*, David C. Garrison, West Newton.

MICHIGAN, 1—*Fellow*, J. Van Tyne, Ann Arbor.

NEW MEXICO, 1—*Associate*, A. E. Borell, Albuquerque.

NEW YORK, 6—*Fellows*, Arthur A. Allen, Ithaca; James P. Chapin, New York City. *Associates*, John H. Baker, New York City; George E. Hix, Brooklyn; Adrian Lambert, New York City; Carll Tucker, Mt. Kisco.

NOVA SCOTIA, 1—*Associate*, Ronald W. Smith, Wolfville.
OHIO, 3—*Member*, Lawrence E. Hicks, Columbus. *Associates*, David D. Blyth, Columbus; William C. Herman, Cincinnati.
ONTARIO, 2—*Fellow*, P. A. Taverner, Ottawa. *Associate*, J. Murray Speirs, Toronto.
OREGON, 3—*Member*, Stanley G. Jewett, Portland. *Associates*, Harold S. Gilbert, Portland; John B. Price, Portland.
PENNSYLVANIA, 1—*Associate*, Harry T. Underdown, Elkins Park.
TENNESSEE, 1—*Member*, Albert F. Ganier, Nashville.
WASHINGTON, 1—*Associate*, Elizabeth L. Curtis, Seattle.
WASHINGTON, D. C., 6—*Fellows*, Herbert Friedmann, Ira N. Gabrielson, Ernest G. Holt, Frederick C. Lincoln, *N.* L. McAtee. *Associate*, Charles H. M. Barrett.
ENGLAND, 1—*Corresponding Fellow*, David Lack, London.
VENEZUELA, 1—*Associate*, William H. Phelps, Caracas.

ELECTION OF OFFICERS

The election of officers for 1940 resulted as follows: *President*, J. P. Chapin; *Vice-presidents*, J. L. Peters and George Willett; *Secretary*, Lawrence E. Hicks; *Treasurer*, Rudyerd Boulton; *Members of the Council* (in addition to officers and ex-presidents), for three years, P. A. Taverner, Ludlow Griscom and Alden H. Miller.

The Council elected Glover M. Allen, Editor of 'The Auk'; Rudyerd Boulton, Business Manager; George H. Stuart, 3rd, C. H. Riker and Edward Norris, Trustees; and J. P. Chapin, S. S. Gregory, Jr., Rudyerd Boulton, W. L. McAtee, and Lawrence E. Hicks, members of the Finance Committee.

ELECTION OF FELLOWS, MEMBERS AND ASSOCIATES

FELLOWS, 2—Alden H. Miller, Berkeley, California; George Willett, Los Angeles, California.
HONORARY FELLOW, 1—Oscar Heinroth, Berlin, Germany.
CORRESPONDING FELLOWS, 2—G. C. A. Junge, Leiden, Netherlands; David Lack, London, England.
MEMBERS, 7—Emmet Reid Blake, Chicago, Illinois; Louis Walter Campbell, Toledo, Ohio; Owen Justus Gromme, Milwaukee, Wisconsin; Joseph A. Hagar, Marshfield Hills, Massachusetts; Paul Kellogg, Ithaca, New York; Wesley Frank Kubichek, Washington, D. C.; Ivan Rexford Tomkins, Savannah, Georgia.
ASSOCIATES, 499—The names of Associates who have qualified will appear in the membership list in 'The Auk' for April, 1940.

DECEASED MEMBERS

During the year the Union lost 23 members by death: 4 Fellows, 1 Fellow Emeritus, 1 Honorary Fellow, 2 Corresponding Fellows, 2 Members and 16 Associates.

DR. SAMUEL PRENTISS BALDWIN,[1] Life Fellow (1917), aged 70, died at Cleveland, Ohio, on December 31, 1938.
DR. JOSEPH GRINNELL,[2] Fellow (1894), aged 62, died at Berkeley, California, on May 29, 1939.

[1] For obituary notice, see Auk, 56: 210, 1939; 57: 1, 1940.
[2] " " " " " " 56: 363, 1939.

DR. JOHN CHARLES PHILLIPS,[1] Fellow (1904), aged 62, died in southern New Hampshire, on November 14, 1938.

DR. WITMER STONE,[2] Life Fellow (1885), aged 73, died at Philadelphia, Pennsylvania, on May 23, 1939.

ALFRED WEBSTER ANTHONY, Fellow Emeritus (1885), aged 74, died at San Diego, California, on May 14, 1939.

DR. ROBERTO DABBENE, Honorary Fellow (1916), died in his 75th year, at Buenos Aires, Argentina, on October 20, 1938.

MONTAGU AUSTIN PHILLIPS, Corresponding Fellow (1919), aged 60, died in London, England, on January 11, 1939.

DR. FRIEDRICH STEINBACHER, Corresponding Fellow (1934), died at Berlin-Friedrichshagen, Germany, on February 15, 1938 (see obituary in 'Journal für Ornithologie,' pp. 302–307, 1938).

STUART TAYLOR DANFORTH,[3] Member (1916), aged 38, died at West Boylston, Massachusetts, on November 25, 1938.

DR. WILLIAM CABELL RIVES,[4] Member (1885), died in his 89th year, at Washington, D. C., on December 17, 1938.

ELIZABETH WILSON FISHER, Honorary Life Associate (1896), died at Philadelphia, Pennsylvania, about February 1939.

MRS. THOMAS ROBY HILL, Associate (1903), died at Philadelphia, Pennsylvania, in 1938 (?).

NORMAN JAMES, Associate (1913), died at Baltimore, Maryland, in January 1939.

JAMES COLUMBUS NEELEY,[5] Life Associate (1919), died in his 72d year, at Brookline, Massachusetts, on March 1, 1939.

HON. HERBERT PARKER,[6] Associate (1920), died in his 83d year, at Lancaster, Massachusetts, on February 11, 1939.

PROF. ALEXANDER HAMILTON PHILLIPS, Honorary Life Associate (1891), died in his 73d year, at Princeton, New Jersey, about March 1939.

HON. EDMUND PLATT, Associate (1917), died in his 75th year, at Chezy, New York, on August 27, 1939 (see obituary notice in 'The Auk,' 57: 139, 1940).

WILLIAM EMILIUS PRAEGER, Honorary Life Associate (1892), aged 73, died at Kalamazoo, Michigan, in 1936.

JAMES HENRY RICE, JR., Associate (1910), died in his 67th year, at Wiggins, South Carolina, on March 23, 1935.

WILLIAM DERRICK RICHARDSON,[7] Associate (1917), aged 60, died at Chicago, Illinois, on January 14, 1936.

EDWARD SIDNEY SCHMID, Associate (1931), died in his 83d year, at Washington, D. C., on March 12, 1939.

MRS. WILLIAM VAN SCHOONHOVEN, Life Associate (1925), died at New York City, on December 25, 1937.

WILLIAM ENOS SHERRILL, Associate (1922), died in his 70th year, at Haskell, Texas, on March 9, 1938.

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[1] For obituary notice, see Auk, 56: 111, 1939.
[2] " " " " " 56: 363, 1939.
[3] " " " " " 56: 362, 1939.
[4] " " " " " 56: 502, 1939.
[5] " " " " " 56: 363, 1939.
[6] " " " " " 56: 362, 1939.
[7] " " " " " 56: 503, 1939.

JOSEPH SIMONS,[1] Associate (1929), died in his 69th year, at Chicago, Illinois, on April 29, 1935.

ROLLIN BURDETTE TROUSLOT, Associate (1933), died in his 78th year, at Walnut Creek, California, about April 1939.

FRANK SMITH WRIGHT, Associate (1917), aged 81, died at Auburn, New York, about March 1939.

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[1] For obituary notice, see Auk, 56: 503–504, 1939.

ANNUAL REPORT OF TREASURER FOR YEAR ENDING SEPTEMBER 30, 1939

Receipts

Membership dues:		
for the year 1939	$4,300.00	
for previous years	130.00	
in advance (for 1940, etc.)	432.00	
		$4,862.00
Subscriptions to 'The Auk'		882.74
Sales of publications:		
back numbers of 'The Auk'	$ 277.53	
4th edition 'Check-lists'	336.40	
miscellaneous	213.88	
		827.81
Contributions:		
to publication of 'The Auk'	$ 340.05	
to expenses of California meeting	150.00	
		490.05
Life Membership fees		225.00
Income from investments:		
Life Membership Fund	$ 577.12	
William Brewster Fund	249.37	
Ruthven Deane Fund	137.03	
		963.52
		$8,251.12

Disbursements

Publishing 'The Auk':			
Manufacture and distribution:			
April, 1938 (balance)	$ 530.40		
July, 1938	1,590.98		
October, 1938	1,310.73		
January, 1939	941.36		
April, 1939	1,087.23		
		$5,460.70	
Honorarium to Editor		600.00	
Expenses of Editor		16.28	
Handling reserve stock of publications:			
services and postage	$ 106.12		
inventory	216.79		
		322.91	
Purchases of back numbers of 'The Auk'		89.00	
			$6,488.89

Expenses of Treasurer and Business Manager:		
Secretarial service	$ 596.40	
Stationery and supplies	198.77	
Postage and express	205.03	
Telephone and telegraph	7.51	
Furniture and fixtures	58.97	
Bank clearance and foreign exchange	32.31	
Miscellaneous	2.17	
		1,101.16
Expenses of the Secretary:		
Secretarial service	$ 61.30	
Washington meeting	33.00	
Postage and telephone	82.34	
Printing	100.50	
		277.14
Brewster Memorial award:		
Cost of medal	$ 200.47	
Honorarium to Dr. T. S. Roberts	48.90	
		248.37
Addition to principal of Life Membership Fund		225.00
Contributions:		
Zoological Society of London	$ 25.00	
International Committee on Nomenclature	10.00	
Expenses of Local Committee (Berkeley, California)	150.00	
		185.00
		$8,526.56

RECAPITULATION

Balance October 1, 1938		$ 416.80
Receipts for fiscal year	$8,251.12	
Disbursements for fiscal year	8,526.56	
Excess of disbursements over receipts		275.44
Balance, September 30, 1939		$ 141.36

The firm of Arthur Young and Company has audited the foregoing report and says, in part: "A comparison of the financial position of the Treasurer at October 1, 1938, and September 30, 1939, will show an improvement as follows:

Accounts payable, October 1, 1938	$2,153.57	
Less cash in bank	416.80	
Deficit October 1, 1938		$1,736.77
Accounts payable, September 30, 1939	$ 987.15	
Less cash on hand and in bank	141.36	
Deficit September 30, 1939		845.79
Net improvement (decrease in deficit)		$890.98"

A committee consisting of Messrs. Chapin, McAtee, Hicks, and Gregory has accepted the report on behalf of the Union.

The honorary and life memberships on September 30, 1939, were as follows: Patrons, 2; Fellows Emeriti, 4; Honorary Fellows, 23; Life Fellows, 9; Life Members, 20; Life Associate members, 82; Honorary Life Associate members, 47. These 187 individuals (and 35 free exchanges) received 'The Auk' for 1939 without payment of annual dues, as is customary. The annual membership in good standing on September 30, 1939, was as follows: Fellows, 39; Members, 105; Associate members, 1280; Associate members-elect, 39; subscribing Corresponding Fellows, 12; a total of 1480. Also there were 186 paid subscribers. The total circulation of Volume 56 of 'The Auk' was thus 1888. There were also 86 Corresponding Fellows of whom 12 subscribed to 'The Auk,' as above.

A complete inventory of the stock of publications for sale by the Union was taken. The reserve stock is in New York, an active stock is in Lancaster from which back numbers of 'The Auk' can be sent by second-class mail, and certain rare issues are in Chicago. The total inventory consisted of 29,405 copies of 'The Auk' and about 4000 other items. New price-lists were prepared and distributed.

Some of the larger contributions to current expenses of the Union were from the estate of the late Stuart T. Danforth, from Edw. A. McIlhenny, and from the Berkeley local committee which returned the Union's contribution toward its expenses. Much needed copies of rare issues of 'The Auk' were received as gifts from a number of individuals.

A number of non-recurrent items occur in the expenses of the past fiscal year. Among them are the taking of the complete inventory of publications, and some of the postage and express due to two annual meetings in the period covered by the report, and to the transfer of the business office of the Union to Chicago. It is anticipated that the Union will have all of its current income available for current expenses within another year and that the drastic curtailment in the number of pages published in 'The Auk' can be somewhat relaxed.

RUDYERD BOULTON, *Treasurer and Business Manager*

THE AUK

A Quarterly Journal of Ornithology

ORGAN OF THE AMERICAN ORNITHOLOGISTS' UNION

Manuscripts should be typewritten if possible. As an aid in bibliography, titles should be brief. References to literature, if few, may be inserted in parenthesis at the appropriate places in the text, or listed at the end of the paper rather than in footnotes. Roman numerals and extensive tables are to be avoided. Line drawings intended for text illustrations should be in India ink; half-tones cannot be printed in the text since the paper is unsuitable. Longer articles should have a brief summary at the end. Except on request, no proofs of 'General Notes' or short communications will be submitted to authors.

Twenty-five copies of leading articles are furnished to authors free of charge. Reprints from 'General Notes,' 'Correspondence,' etc., must be ordered from the Editor when the manuscript is submitted.

All articles and communications intended for publication and all books and publications intended for review should be sent to the Editor,

DR. GLOVER M. ALLEN
Museum of Comparative Zoology
Cambridge, Mass.

Subscriptions, requests for back numbers of 'The Auk,' as well as for other publications of the Union, changes of address and remittances should be sent to the Treasurer and Business Manager,

RUDYERD BOULTON
Field Museum of Natural History
Chicago, Illinois

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A recent survey of the stock of back numbers of 'The Auk' available from the Treasurer's Office has been made with the result that the status of certain hitherto rare or unobtainable issues is considerably changed. The Council, at the Annual Meeting in Berkeley, authorized the present scale of prices which supersedes all others published, as of October 1, 1939. Orders will be filled in the order in which they are received. Attention is called to the discounts granted on orders of more than five volumes.

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